

PC MAGAZINE

An End to the One-Horse NOS Race

PC Labs Pits 5 Formidable Competitors
Against the NetWare 3.12 Standard

NETWORK EDITION

Alive and Well:
Three Peer-to-Peer
LANs Find New Life
In the Small Office

Nine Flowcharting
Packages to
Turn Process
Into Picture

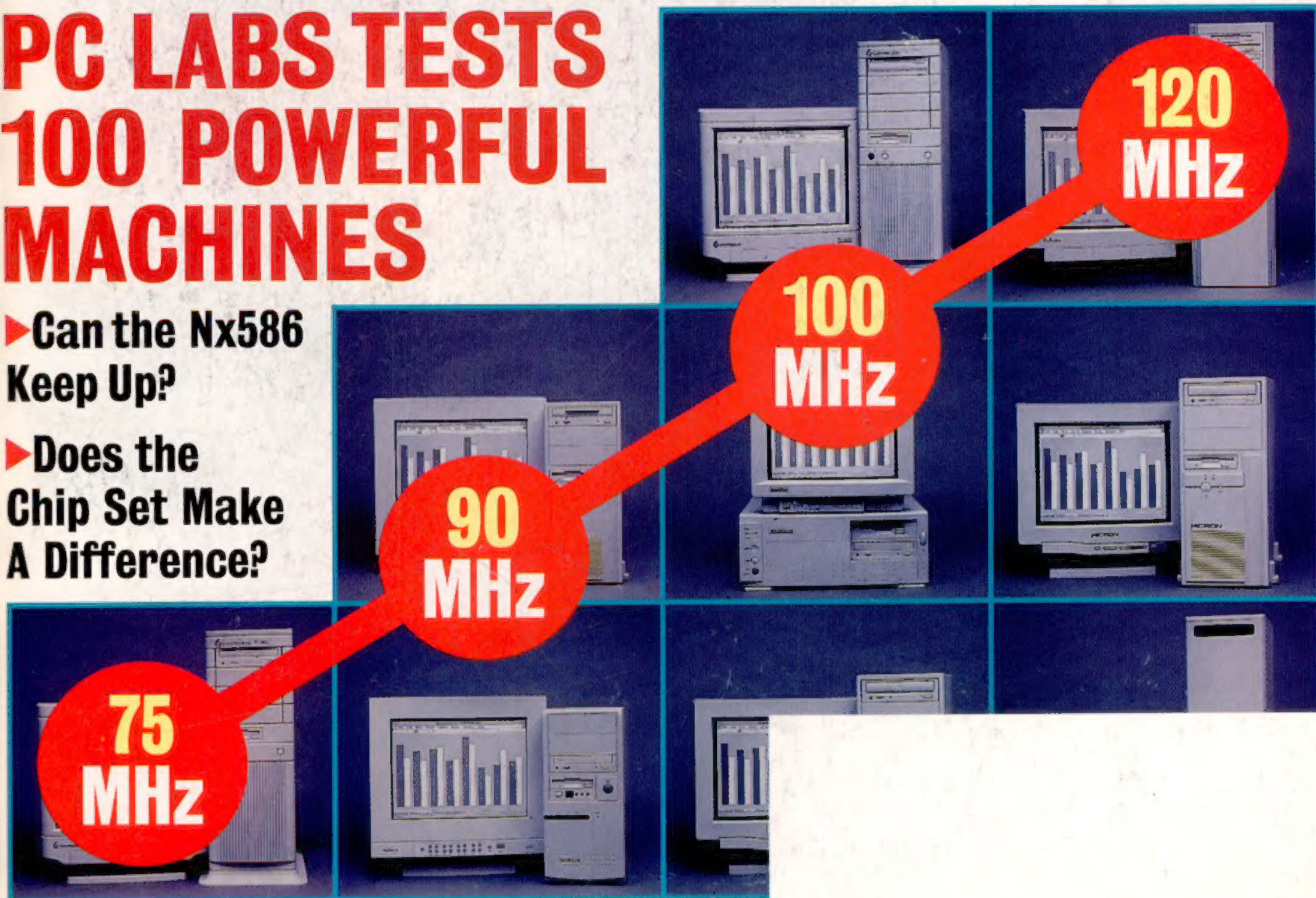


Pentiums

PC LABS TESTS 100 POWERFUL MACHINES

► Can the Nx586
Keep Up?

► Does the
Chip Set Make
A Difference?



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Inside

For years, the heart of *PC Magazine* has been our labs-based testing. We spend more time on testing, retesting, and double-checking our test results for products (not to mention developing new and better tests) than on just about

anything else we do.

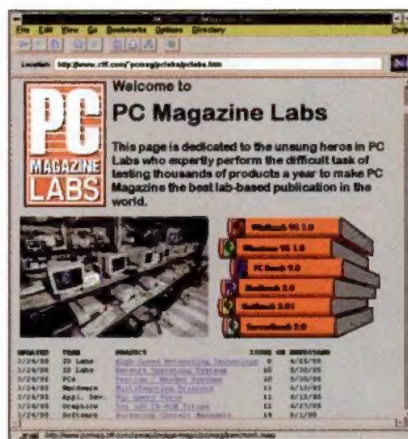
For weeks, PC Magazine Labs in New York looked more like a computer warehouse than a lab. You'll see the results in this issue. The labs portion of our PCs team, headed by project leader Rich

Meanwhile, our West Coast branch of PC Labs (working out of ZD Labs facilities in Foster City, California) was busy testing a whole new generation of network operating systems. Headed by director Steve Buehler, technical director Rob Lipschutz, and project leader Jeff Witt, the Labs staff put the major NOSs through their paces, concentrating on such evolving technologies as directory services and integration. The results will help you decide your networked future.

A number of readers have asked about tours of PC Labs or ZD Labs. Now we can give you the next best thing, in the form of a PC Labs Online set of pages on the World-Wide Web. Part of the overall "PC Magazine on the Web" ser-

vice (<http://www.pcmag.ziff.com>), these pages let you download many of our benchmark tests and test results from previous issues. You can also scan our schedule of upcoming testing and even view pictures of the process as testing progresses.

We think this new addition to our Web family is pretty cool, and we hope you'll check it out. That's it for now; back to the Labs to work on the next issue!—*Michael J. Miller*



PC Magazine Labs: A view from the Web.

Fisco and supervised by technical director Nick Stam, spent months doing hands-on testing to compare 100 new Pentium- and Nx586-based PCs. During the final stages of testing, they were thrown a curve ball with the introduction of the new 120-MHz machines; even so, they managed to include the Pentium 120s in this issue's feature. The result may be the most complete look at the world of the Pentium you will ever see.

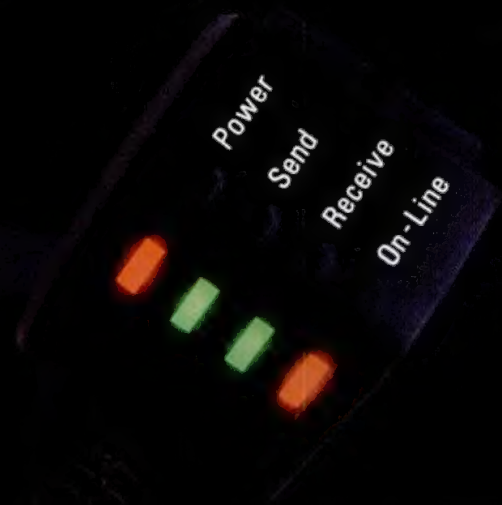
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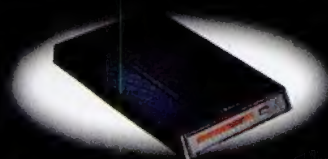
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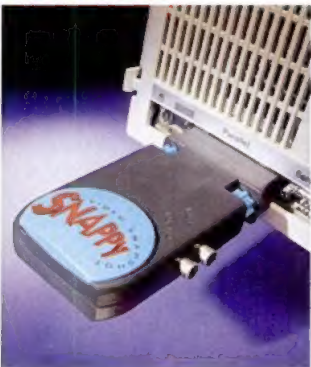
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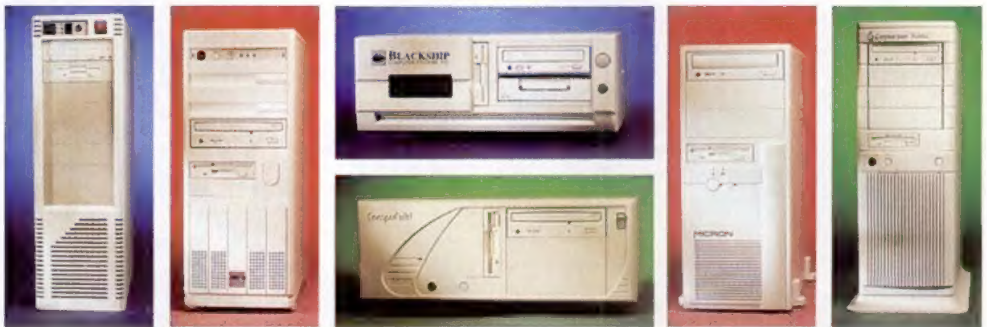
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PCs

TAPPING THE PROMISE
OF THE PENTIUM

BY JOHN CLYMAN

The question is no longer *whether* you should buy a Pentium system; it's *which* Pentium system to buy. And there are plenty of choices, from bargain-priced 75-MHz models, which are displacing 60- and 66-MHz versions, to units built around the 120-MHz chip, which is setting speed records. NexGen has also gotten into the act: The company claims that its Nx586 CPUs match the Pentium's performance. How do the chips really stack up? We test 100 systems to find out102



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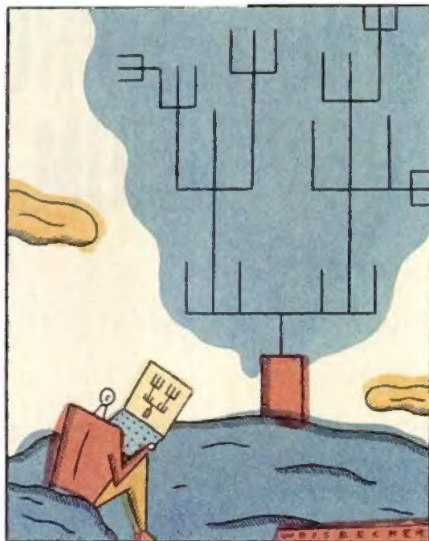
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BY EDWARD MENDELSON

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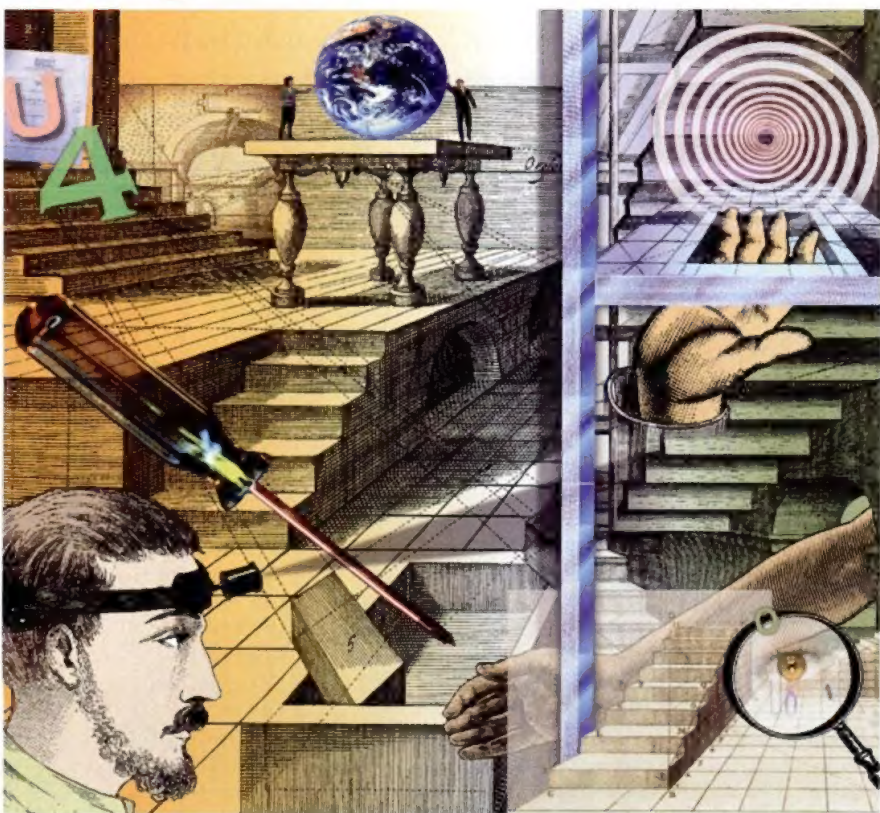


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The Versatile
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OPERATING
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With directory services, enhanced migration and integration utilities, and tempting application services, network operating systems from Banyan, IBM, Microsoft, and Novell are clamoring for your dollar. We'll tell you which to buy and take a close look at application servers.....228



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Serial Port Modem with Windows

WHAT HAPPENS TO WINDOWS DATA WITH AN ORDINARY MODEM.

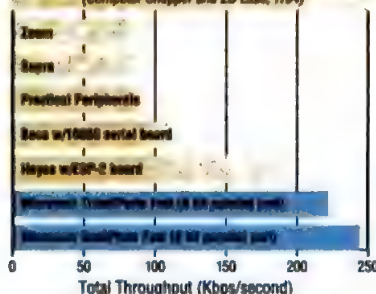
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Parallel Port Modem with Windows

WHAT HAPPENS TO WINDOWS DATA WITH A MICROCOM MODEM.

Modem Performance in Windows
(Computer Shopper and ZD Labs, 7/94)



The problem with ordinary modems is the serial port bottleneck. At high speeds, Windows data slams on the brakes as it tries to squeeze through your modem's **serial port—which can only transfer data one bit at a time**. Results: slower performance, frequent loss of data and higher phone charges.

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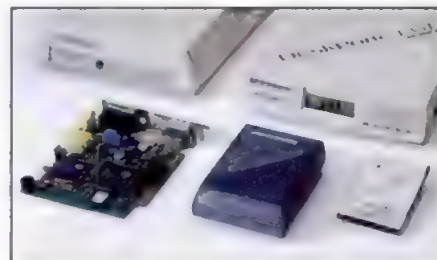
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As the ZD Labs chart clearly shows, this solution is a winner. In fact, the DeskPorte FAST 28.8 was "Experts' Pick" in the July '94 issue of *Windows Sources*. Both Microcom modems they tested achieved "...the highest overall throughput of any rival."

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SCALABLE?

Add another card, add another modem, rearrange the spaghetti, push the whole mess back into the closet, hope nothing comes loose or gets unplugged.

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Once you've sorted out this mess, you can sit back and start listening to the complaints about performance bottlenecks, serial port speeds, and woefully slow UARTs that process byte-by-byte, character-by-character, interrupting your server to fetch minuscule chunks of data.

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Now it's really easy for you to extend your network operating system along with all of your applications, from e-mail to database services, to all of your remote users without stocking and maintaining a closet full of modems, cables and power supplies.

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Insert a Netaccess MultiPort Modem

Card in your server and load the drivers for your Novell NetWare Connect or Microsoft Remote Access Service. If you're working in a different OS environment, just configure the Xircom Netaccess card for comports. It's really that simple. Your remote users now have full access to all the applications and services they use on their LAN locally.

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RELIABLE:

With the RJ-11 connectors attached directly to the Netaccess MultiPort Modem Card, the vast majority of cables and power supplies of external modems are eliminated. MTBF for a Netaccess MultiPort Modem Card with four V.34 modems is 41,791 hours. Calculated MTBF for a Netaccess MultiPort Modem Card with eight modems onboard is 23,076 hours.

PERFORMANCE:

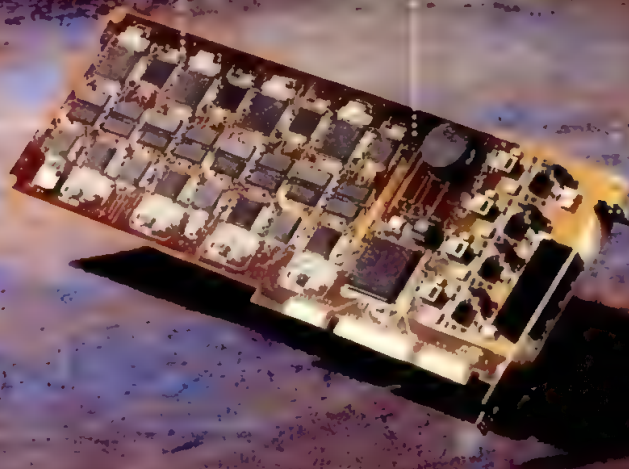
No waiting for UARTs, no serial port bottlenecks, just big blocks of data moving swiftly and smoothly between your Netaccess MultiPort Modem Card and your server.

MANAGEABLE:

The Xircom Netaccess MultiPort Modem Card lets you monitor the status of your local modem connections, including speed, type of compression in use, type of error detection in use and more on your SNMP workstation.

SCALABLE:

Add another four or eight ports by adding another Netaccess MultiPort Modem Card to a maximum of 64 ports per server depending upon host system resources. No mess, no fuss, very little spaghetti.



REMOTE ACCESS UNDER CONTROL.

reliability of other remote access solutions and none of the nasty maintenance hassles that come along with serial port boards.

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scalable, reliable and totally compatible with the network operating system you're running today. So don't let remote access get out of control in a closet full of modems, cords and twisted spaghetti.

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John Dvorak, *PC Magazine*, March 30, 1993

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Jerry Pournelle, *Byte*, April 1993

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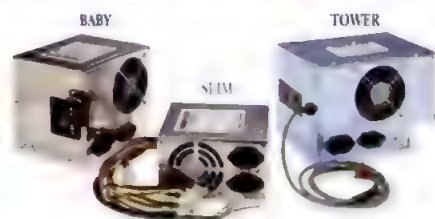
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Ed Bott, *PC Computing*, October 1994



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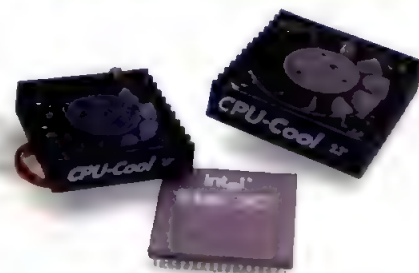
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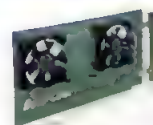
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Letters

THE INTERNET COMES OF AGE

The outpouring of mail we received lauding our electronic publishing coverage ("Publish Without Paper!", February 7, 1995) and our round-up of World-Wide Web browsers offers further testament to the growing popularity of the Internet and the World-Wide Web.

The round-up of World-Wide Web browsers was very informative. It was a great summary of the current offerings, or at least of the current offerings as of that week. I was particularly thrilled to find the sidebar "Connecting to the Web: New Twists" concerning the latest developments in non-SLIP attachments to the Web. This is just what I have been waiting for. About an hour after downloading Slip-Knot 1.0, I was surfing the Web to my heart's content. If I can't have a SLIP connection, this is definitely the next best thing. Little tidbits of information like this are what rewards me for reading your magazine.

JOHN H. GRANT, via PC MagNet

Talk about being right on target! Compliments on a job well done. Your issue on electronic publishing and the World-Wide Web was so well written and well organized that I've saved the whole thing.

MICHAEL ASH, via the Internet

It was good to see coverage of SGML (Standard Generalized Markup Language). The SGML world is growing, and so is the influence of the standard and its derivatives.

BRIAN E. TRAVIS, via the Internet

Your coverage of HTML browsers was particularly useful, while your descriptions of SGML will help open many eyes to this important device-independent standard for representing document content.

REBECCA O. BARCLAY, via PC MagNet

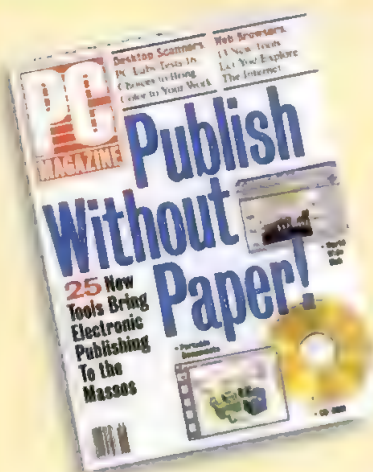
It's exciting that the mainstream has finally recognized SGML after so many years of neglect. Your article demonstrated a fair understanding of the intricacies and power of SGML, and you did a good job presenting a complex topic.

LOYD HARDING, via the Internet

Thanks for an unbelievably insightful issue. You have truly untangled the Web. Kudos all around.

DAVID GRUNWALD, via the Internet

Because of PC Magazine's coverage of the Internet, I finally joined the world of the connected. Armed with a fresh cup of coffee, I spent my first 3 hours delightfully surfing round the info-world. Unbelievable! And not a hitch or a glitch in the process. How could I



This was a great summary of the current Web offerings as of that week.

have waited so long for something this capable and compelling?

JIM WALKER, via the Internet

Thanks for the article on the World-Wide Web. It was interesting to read about the software solutions for accessing the Web, especially since it's still all so new.

JOHN CRAWFORD, via the Internet

The roundup of World-Wide Web browsers was enjoyable and informative. Thanks for the discussion of IBM's WebExplorer for OS/2.

JOSEPH M. RAMIREZ, via the Internet

Thank you for the info-packed issue about the Internet, services, clients, and systems. We here at Lawrence Livermore National Lab found the pointers very informative. Many people have difficulties configuring their Web browsers with all of the available external viewers for graphics, video, and sound. We have put together a viewer test page available at our Web site at URL <http://www-dsdl.llnl.gov/documents/WWWtest.html>. The idea is that someone goes to this page and presses all of the test buttons to test his external viewers. If something doesn't work, then the user can download the missing viewer. There are viewers for PCs, Macs, and other systems.

SCOTT D. NELSON, via the Internet

The availability of inexpensive software to create electronic documents quickly and easily is an exciting step forward in electronic publishing. And what could be more appropriate in this day of political correctness than

electronic publishing? It saves trees, time, money, and resources.

JAMES STOKER, Ames, Iowa

DISTORTED ON-LINE REALITIES

Bill Machrone must be kidding about spending \$50 a month or more on CompuServe's forums with an off-line reader ("On-Line Reality: Alternate Universes," February 7, 1995), even if he is using CompuServe's old rates. At the current rates, \$50 buys you over 10 hours of connect time. Any off-line readers and a 14,400-bps modem would dump scores of messages and files on your machine in that much time. If I had to choose between the organization and quality of CompuServe and the chaotic, wildly uneven Internet, it wouldn't be a tough decision.

CASEY ABELL, via PC MagNet

Machrone complains that finding something based on the World-Wide Web's naming scheme is difficult and could take hours, but I disagree. The names couldn't be more clear, since they are based on the standard naming method that the Internet has used for years.

SETH ARNOLD, via the Internet

RESPONSES TO THE PENTIUM DEBACLE

The troubled history of Pentium problems Robin Raskin describes in her Pipeline column "Pentium Means Having to Say You're Sorry" (February 7, 1995) is a bit surprising. The fact of the matter is, the biggest problems with the Pentium have been in the way that Intel handled the floating-point unit's flaw.

SCOTT WILLSEY, via the Internet

The Trends article "What Happens when You Call Intel?" (February 7, 1995) stated that Intel's support personnel promised replacement of defective Pentiums within four weeks. But that's a fantasy world. First I called Intel on January 3 and was told my replacement would take four weeks. When I checked the status again, I was told that the CPU would probably "ship today." Three months later, Intel had still not shipped a replacement CPU to me. That is the reality.

HARRY ROGERS, via the Internet

Thank you for your enlightening articles and white papers on Intel's Pentium chip errors, as well as utility software to check your own chip. My experience with Intel was as smooth as could be. The total time from first call to CPU replacement was approximately six weeks.

ALBERT NAKAO, via PC MagNet

John C. Dvorak's column (Inside Track, February 7, 1995) really takes Intel to task over the Pentium debacle. Yet when I called Intel for a replacement chip, Intel handled the situ-

“So we looked for groupware that could bring



The first one was **supposed** to be user friendly.

The next promised compatibility.



been okay. If we had lots of **time** to waste.



group, isn't there something that can turn us

us all together.



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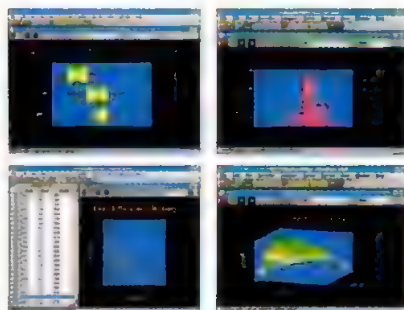
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Letters

ation very professionally, and I had the replacement within 30 days. No one could expect better service from any company.

ROBERT T. HORGAN, via *PC MagNet*

Your series of articles on the Pentium fiasco (in the issues of February 7 and 21, 1995) were great; they offered a thorough explanation of what the flaw is and how to avoid it, as well as an analysis of the economic implications of the flaw. It was refreshing to read about both sides of the issue, thanks to your coverage of both IBM's and Intel's perspectives. I hope Intel has learned its lesson. Maybe next time the decision to recall chips will be quicker one.

JEAN-MARC GORELICK, via *the Internet*

John C. Dvorak is on target in his column "A Modest Pentium Proposal" (February 21, 1995) except for his unrealistic expectations of perfection in a new CPU chip. The problem lies in the combinatorial nightmare represented by the many things that can go wrong in complex instruction set processors. It's not possible to design checkout programs that test more than a small subset of the possibilities.

DWIGHT L. JOHNSTON, via *the Internet*

Thanks to Dvorak for keeping Intel honest. When problems like the Pentium bug crop up it gives the whole computer industry a bad image.

ROBERT LASSEN, Ames, Iowa

Michael J. Miller still doesn't get it ("Once Lost, Can Trust Be Regained?", February 21, 1995). He bemoans the fact that the Intel Pentium floating-point problem is over-

CORRECTIONS AND AMPLIFICATIONS

The number included in the New & Improved column entry on Shortcut Software Corp. (April 11, 1995) was the company's fax number. Its business number is 800-521-9414.

blown, and that many users will not even be "on the floating-point road." Yet I certainly wouldn't want to know that my purchase is viable only if I never use it for certain serious floating-point operations. Why should consumers pay more for a Pentium than the combined equivalent of a dedicated word processor and a Super NES if that's all that they can safely use it for?

RICK HOROCHOLYN, via *the Internet*

Miller is right to say that the Pentium problem was overblown. Frankly, I'm tired of hearing about it.

DAN KELLGREN, Poland, Ohio

Thanks to Michael J. Miller for giving readers a simple test for their computers and a fine article (Trends, "Intel or IBM: Whom Do You Trust?", February 7, 1995) that brought together all of the facts and the myths in an easy-to-read article.

W.J. MCCARRELL, Fallon, Nevada

Thank you for a very informative section on the Pentium bug. I appreciate that you took the space to elaborate on how the bug affects various users and included the sidebar regarding software detours. You provided timely and pertinent information.

TRACEY KIRKPATRICK-PRITCHETT, via *PC MagNet*

The only thing Intel is really guilty of is incredibly poor customer relationships. The company should have acknowledged the problem, offered an exchange, and watched almost no one take advantage of it. People want the right to exercise a choice even though they will probably never will.

JEFF V. PULVER, via *PC MagNet*

It was bad enough that Intel put the flawed Pentium chip into production. But it was indefensible to pretend that the flaw didn't matter.

JOHN RUSSELL, Calgary, Alberta, Canada

Intel has long been regarded as a responsible and reputable company. The Pentium chip fiasco will have a long-term impact on the company's reputation.

JOHNNY PATTERSON, Irving, Texas

To those with Pentium processors in their computers: Dust off your slide rule to check your processor's math accuracy.

DON JUDSON, Midland, Texas

HOW TO CONTACT US

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COMPUSERVE 72241.104, or to individual editors as listed on ZiffNet (type GO PCMSTAFF)

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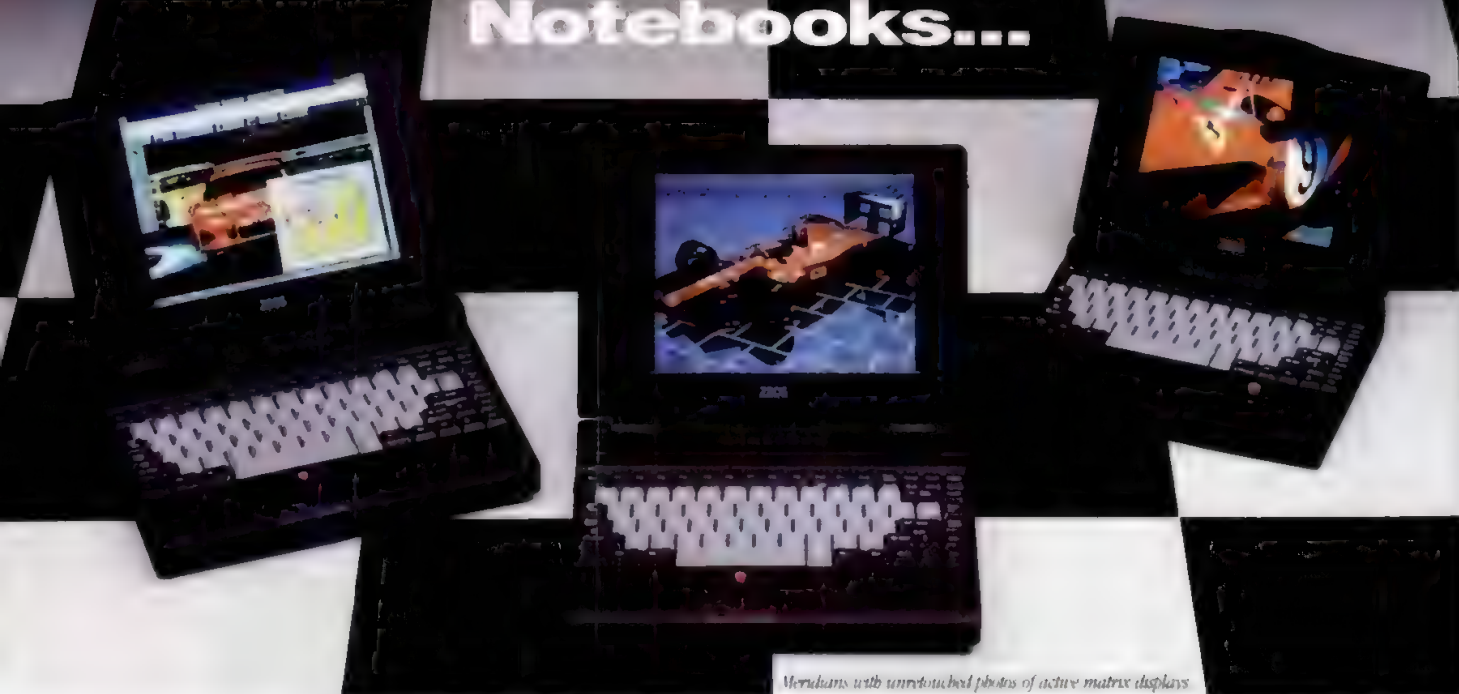
of 270, 425, 540, 850 and

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ZEOS MeridianTM Notebooks...



Meridians with untinted photos of active matrix displays

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"ZEOS is out to prove that good things do come in small packages with its Meridian 400C subnotebook," reported *Windows Magazine*.

At 3.9 pounds, the Meridian 400 subnotebook is molded from a special carbon fiber material that cuts weight and increases durability. And with

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486 & DX4	Package 1			Package 2			Package 3		
	Dual Color	400C	800C	Dual Color	400C	800C	Dual Color	400C	800C
	486DX2-50	\$1995	\$2195	486DX2-50	\$2295	\$2395	486DX2-50	CNI \$2595	CNI \$2695
	DX4-100	\$2395	\$2595	DX4-100	\$2695	\$2795	DX4-100	CNI \$2995	CNI \$3095
	Active Color	400A	800A	Active Color	400A	800A	Active Color	400A	800A
	486DX2-50	\$2695	\$2995	486DX2-50	CNI \$2995	\$3195	486DX2-50	CNI \$3295	CNI \$3495
	DX4-100	\$3095	\$3395	DX4-100	CNI \$3395	CNI \$3595	DX4-100	CNI \$3695	CNI \$3895
	➤ 4MB RAM ➤ 260MB IDE hard drive ➤ 800: Internal 3.5" 1.44MB floppy drive ➤ MS-DOS 6.2			➤ 8MB RAM ➤ 350MB IDE hard drive ➤ 3.5" 1.44MB floppy drive. 400: External, 800: Internal ➤ Custom nylon carrying case ➤ MS-DOS 6.2, Windows for Workgroups 3.11 ➤ Lotus Organizer			➤ 8MB RAM ➤ 350MB IDE hard drive (400), 528MB IDE hard drive (800) ➤ 3.5" 1.44MB floppy drive. 400: External, 800: Internal ➤ 14.4 PCMCIA fax/modem ➤ Custom carrying case. 400: Leather, 800: Nylon ➤ Extra battery ➤ MS-DOS 6.2, Windows for Workgroups 3.11 ➤ Lotus Organizer		

Pentium	Package 1		Package 2		Package 3	
	Dual Color	850C	Dual Color	850C	Dual Color	850C
	Pentium-75	\$3495	Pentium-75	CNI \$3995	Pentium-75	\$4395
	Active Color	850A	Active Color	850A	Active Color	850A
	Pentium-75	\$4295	Pentium-75	\$4795	Pentium-75	\$5195
	➤ 8MB RAM, 256K synchronous SRAM cache ➤ 528MB IDE hard drive ➤ Internal 3.5" 1.44MB floppy drive ➤ Integrated 16-bit stereo sound ➤ MS-DOS 6.2, Windows for Workgroups 3.11		➤ 16MB RAM, 256K synchronous SRAM cache ➤ 528MB IDE hard drive ➤ Internal 3.5" 1.44MB floppy drive ➤ Integrated 16-bit stereo sound ➤ Custom nylon carrying case ➤ Extra battery ➤ MS-DOS 6.2, Windows for Workgroups 3.11 ➤ Lotus Organizer		➤ 16MB RAM, 256K synchronous SRAM cache ➤ 810MB IDE hard drive ➤ Internal 3.5" 1.44MB floppy drive ➤ Integrated 16-bit stereo sound ➤ 14.4 PCMCIA fax/modem ➤ Custom nylon carrying case ➤ Extra battery ➤ MS-DOS 6.2, Windows for Workgroups 3.11 ➤ Lotus Organizer	

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- 850: IDE HDD upgradable to 810MB.
- Local bus video with 1MB video RAM.
- PCMCIA slots. 400: 2 Type II, 800 & 850: 2 Type II or 1 Type III.
- Display: Color VGA backlit LCD, up to 256 colors. 400: 640 x 480 7.9" DSTN or active matrix. 800: 640 x 480 10.3" DSTN or 9.5" active matrix. 850: 10.3" 800 x 600 DSTN or 9.5" 640 x 480 active matrix.
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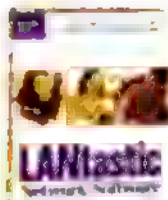
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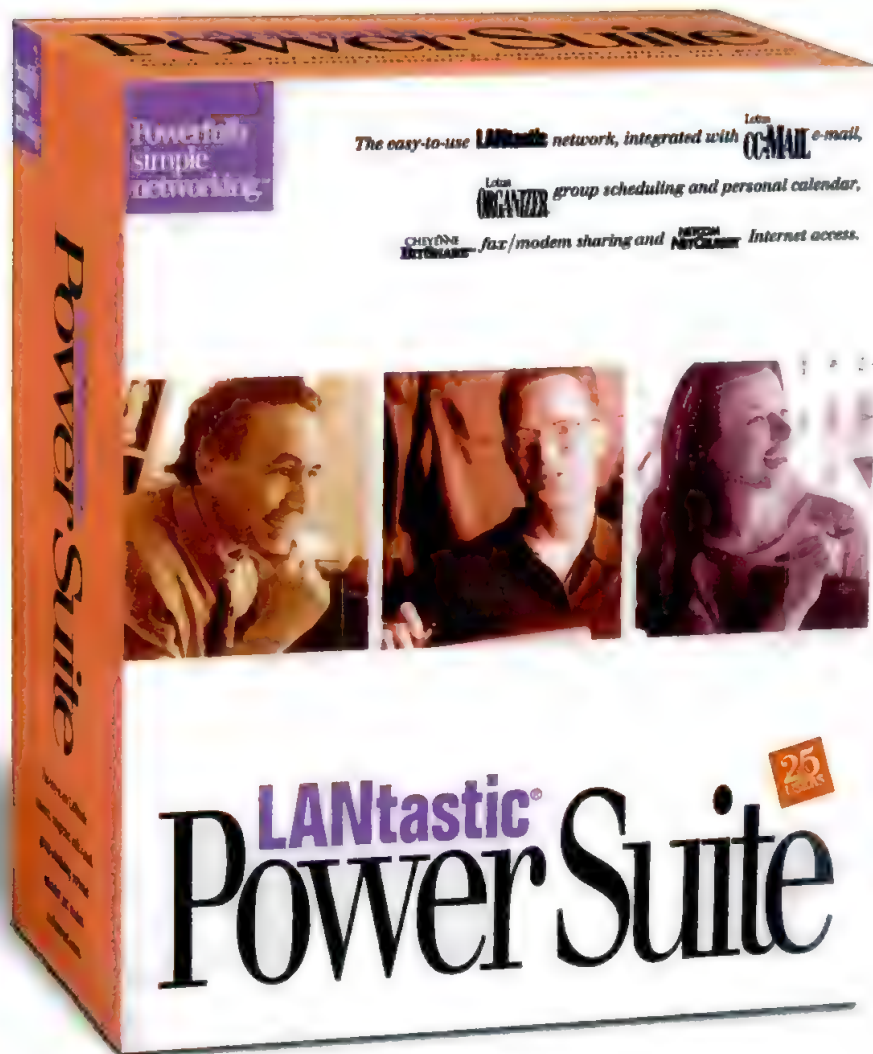
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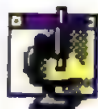
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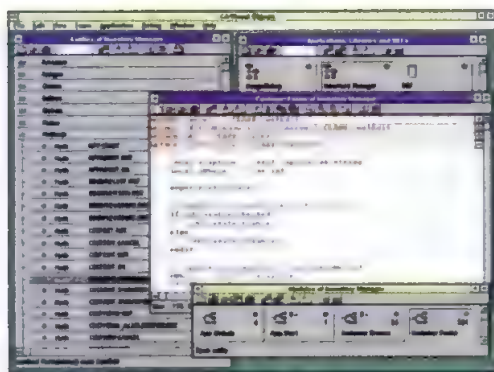
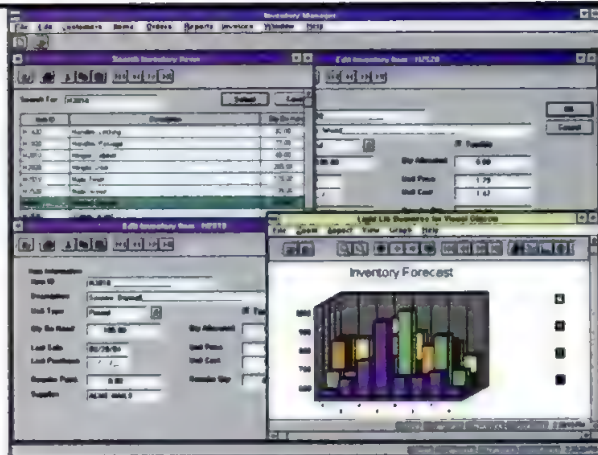
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Trends

TRENDS & TECHNOLOGY SHAPING THE PERSONAL COMPUTER MARKET

High-Protein Computers

The promise of binary biology.

Chemistry professor Robert Birge may look as if he's brewing beer in his lab at Syracuse University, but what he's really doing is recreating the environment of a salt marsh, the ideal incubator for growing bacteria that make a certain protein that shows great promise as

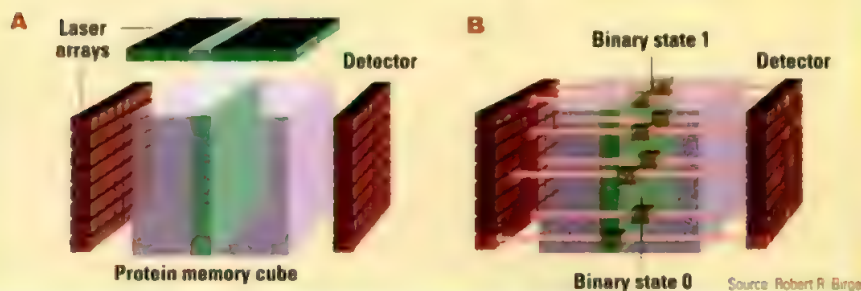
the basis for a radically new kind of memory: protein memory.

Imagine a storage medium the size of a sugar cube that stores a terabyte of information. As odd as it may seem, this device will be based not on silicon transistors, but on protein molecules that change their shape

This branch of bioelectronics emerged in the early 1970s when two scientists observed the structural changes that a protein molecule known as *bacteriorhodopsin* (which is grown by a bacterium that is found in plentiful supply in salt marshes throughout the world) exhibited when exposed to light.

How Does a Cube of Protein Store Info?

When a protein cube absorbs green light (A), it begins the *photocycle* process, in which the protein molecule changes its structure by moving a proton. When red light is then focused on individual molecules (B), a detector picks up a pattern of dark and light indicating binary states 0 and 1, forming the basis for writing and reading information. Protein has shown promise in high-density 3-D memory.



when exposed to light, enabling them to store and transfer massive amounts of data.

While research and development efforts today focus on shrinking the size of silicon transistors, there's also an effort afoot to manipulate tiny protein molecules that may turn out to be economical for storing data on a massive scale. According to Birge, director of the W.M. Keck Center for Molecular Electronics at Syracuse University, "The size of a single logic gate will approach the size of a molecule by about the year 2030."

Later, Soviet scientists recognized the potential of the molecule to act as a switch with *on* and *off* positions, essentially the same binary function that a silicon transistor serves. While silicon alters its state when a current of electricity excites electrons, a protein changes its shape upon absorbing light. A laser beam controls the switching in a matrix of memory cells (see diagram).

So would you feel comfortable entrusting your data to a close relative of a protein shake? While an organic entity seems sus-

ceptible to decay, disease, or a ravenously hungry user, this bacterium and its photosynthetic protein, which thrives naturally in the harsh environment of salt marshes, is resilient and stable. Reliability is another issue. "Writing is a piece of cake. It's reading that's harder," says Birge. Errors crop up because of noise from the laser interfering with the read signal. The goal is to reduce the errors to the level found in silicon.

While in terms of speed, protein-based memory falls somewhere between a high-speed disk drive and semiconductor memory, the advantage is in its ability to read data in parallel. Birge anticipates the major impact of bioelectronics will be in the area of 3-D memory, which stores data in all three dimensions. Magnetic, flash, semiconductor, and optical memory store data only on the surface. "The approach we're taking is to have true volumetric memory where you would gain a 300-fold improvement [in density]," says Birge.

The Syracuse lab has been working on prototypes of protein-based 3-D memory and associative memory (used in neural networks and artificial intelligence), and is preparing to test memory cards in PCs. The question that hasn't been answered yet is whether protein memory is economically viable, especially as flash memory improves.

The first hybrid products that use both semiconductor and protein memory (a system would have, say, 3GB to 24GB of protein memory and 4MB of fast RAM) could reach consumers in as soon as eight years, Birge says optimistically.

But these developments depend on a few contingencies. Inexpensive lasers are needed, and some company will have to buy into the technology. Birge says that three companies are evaluating the technology now. "They range from very, very large down to startup."—Carol Levin

Pipeline By Robin Raskin

This Column Is in Beta

I'm sending this column out to over a million of you, replete with a few half-baked ideas and a couple of typos, and I'm not going to fact-check it. But I promise, it has some revolutionary thoughts that will change the way you think. Just hang in there with me. I promise that by next column I will complete the sentences and finish the thoughts. Better yet, why don't you complete my thoughts? And while you're at it, could you please pay me for that privilege? Hey, something wrong? Everything I've said parallels the business-as-usual practices of the computer industry today.



Our whole notion of product readiness and beta testing needs to be reexamined, and fast. We've come to accept products of inferior quality because we're told that "computers are just like that." A significant part of the problem is that vendors rush products to market at the expense of less-than-solid development and testing practices.

The behind-the-scenes story is disturbing: Marketing folks commit to having a product ready for a certain ship date. Programmers dive in and try to meet the realities of coding. Problems are encountered; schedules slip. Marketing forges on to prerelease the product to the press and analysts who provide a laundry list of "gotta have 'em" changes. Dates slip, but the market demands that a less-than-robust product gets released.

The problem isn't new; it's just escalating. Remember Ashton Tate's \$1,000,000 dBase III recall? The entire shipment was recalled because someone misencoded a serial number on the final disks. Norton Desktop for Windows 2.0 had several slip-

stream releases during the first three months of its existence. OS/2 Warp didn't recognize an AUTOEXEC.BAT or CONFIG.SYS file in the root directory, so it didn't install properly. As *The New York Times* columnist Stephen Manes says, "Didn't anyone in the beta test have an AUTOEXEC file?"

Now the marketing folks are even driving the beta process. To be part of its 40,000-person beta site, you had to pay Microsoft \$30. Can mass participation and a few bucks insure better quality? Recently, these sites have been flooded by almost daily revisions of the beta. Each rev seems to fix a day's worth of problems and fuel two days of new problems.

Corel is taking a different tack with Corel 6. You don't pay—you get paid: The first-tier testers get cash; the second-tier gets gifts. Will money and prizes produce a better quality beta?

The system is about to implode, but there are some signs of encouragement. McAfee Associates is one company trying to change the model. Full, working evaluation copies are available on-line and on CD-ROM. If you like the software, you can buy a two-year subscription that includes technical support, revisions, and any bug fixes.

Recently, I hosted a forum on CompuServe where developers, journalists, and readers shared ideas about how to change the process. Many of the comments hammered on the fact that programmers and marketers need marriage counselors; they need to have the same goal: a product that—to quote Walt Mossberg of *The Wall Street Journal*—"works as advertised." As for software reviewers, we've got to get better at praising solid code and being really hard on bugs.

Things may get worse before they improve as companies start to bang our doors down selling us on the benefits of the new 32-bit apps. The potential for bugs in this complex fledgling code is enormous. We'll get there, but it's time to rethink the road map.

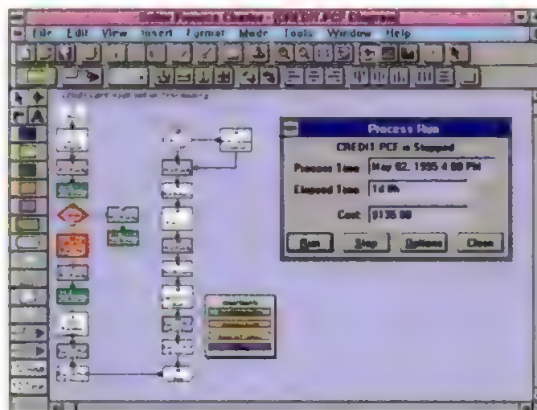
Robin Raskin is editor of PC Magazine.

Redesigning Business with TQM Software

MOVE OVER, LOW-COST PRODUCTION. Total Quality Management (TQM) has companies competing on quality, not just cost. The concept, first preached by quality gurus Deming, Crosby, and Juran in the 1950s and 1960s, seems simple, but today, companies are still struggling to incorporate TQM principles into everyday business.

Now software developers are finding a growing market for programs that help measure and track the success of a TQM program. While a good flowcharting program can provide you with an understanding of your current process flow (see our evaluation of flowcharting packages, "Life Imitates Chart," in this issue), TQM software can help you identify critical elements in your workflow, quantify conformity to customer-based standards of quality, and assess the effects of any changes in the workflow process.

TQM software is designed to answer questions such as whether adding one more bank teller will bring average customer waiting time to under 5 minutes. Some programs,



The simulator in Scitor's Process Charter shows bottlenecks in red and work-path items in green.

such as Integrated Quality Dynamics' PFT for Windows (\$200; 800-870-4200), offer classic diagnostic frameworks, such as Affinity Diagrams for brainstorming and Relationship Diagrams for uncovering cause-and-effect links, that push you to explore complex relationships among elements of your workflow process.

Software can also help reveal variation patterns in business processes. The DataAnalyzer in Micrografx's ABC FlowCharter (\$495; 800-603-0074), for example, produces control charts and Pareto analyses.

Finally, TQM software can help measure the impact of changes. Scitor Corp.'s Process Charter for Windows (\$595; 800-549-9876), for instance, will simulate the process in action and provide a visual display of the work path and trouble spots.

—Catherine Kunkemueller

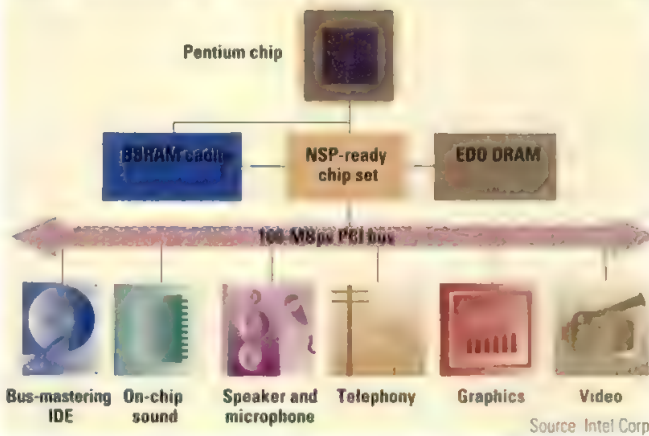
Intel's Road Map = NSP + More Clock Speed

AT THE 1995 WINDOWS HARDWARE engineering conference (WinHEC) in San Francisco, Intel's Albert Yu and Craig Kinnie set forth the company's road map for the next two years. This sparked controversial reactions from competitors and can be summed up in three words: Cheaper, Faster Pentiums.

Intel disclosed the upcoming clock speeds for Pentium chips—133-MHz and 180-MHz Pentiums will arrive this year—as well as more details on its Native Signal Processing (NSP) reference platform. NSP is a set of specifications, including high-speed PCI chip sets and APIs, designed to offload sound, video, and telephony onto the main CPU.

"We're supporting NSP with software-only sound routines written for Intel's APIs, but make no mistake, NSP is confusing and limited, and only raises minimum standards," says Creative Labs' Rich Sorkin. Soundboard and sound-DSP makers have been characterized as threatened by NSP. Carl Stork, Microsoft's director of Windows hardware programs, echoed a policy of support despite confusion: "We're behind Intel on

NSP: Raising the Multimedia/Telephony Standard



parts of NSP, but baffled by the notion that you're going to tie up your host CPU's cycles.

At WinHEC, Intel demonstrated FM-synthesized sound running on a Pentium CPU, and discussed wavetable synthesis and some limited video tasks. AMD's Drew Dutton says wrapping sound onto the main CPU

represents only a slight cost advantage to motherboard makers. "What will be more significant will be when MPEG video decoding and other video-related tasks can happen on the main CPU," says Dutton. At the 1995 CEBit show, Motorola showed its 604 chip doing MPEG video decoding. Motorola's Phil Pompa says the company is looking at other

tasks to assign to PowerPC CPUs.

Still, Intel cites a broad array of tasks that NSP and upcoming Pentium clock-speed increases will facilitate. These include speech synthesis, fax/modem codec, audio special effects, handwriting and speech recognition, and video capture.—*Sebastian Rupley*

Is This the Year for PowerPC?

THE DOORS MAY FINALLY BE OPENING on a healthy PowerPC market now that several long-awaited catalysts have recently come together. Apple and IBM have agreed on a near-final architectural block diagram

Even PC manufacturers, who have disdained the PowerPC platform for its nebulous operating-system identity, dearth of native applications, and lack of support by major large system manufacturers, are slowly taking the bait.

IPC in Austin, Texas, for example, is shipping an under-\$3,500 PREP-compliant PowerPC 604-based PC, equipped with Windows NT, 16MB of RAM, and a professional-level graphics subsystem.

Some other players, though, see dark clouds in the PowerPC picture. "Lack of a software

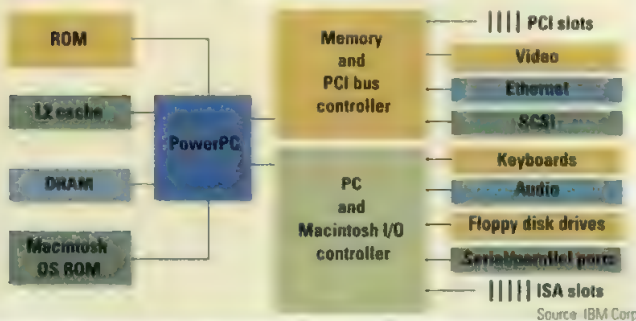
P6), including the upcoming under-\$500 MIPS R4700 and Digital's Alpha 21164 module, which runs at 266 MHz and performs 1 billion instructions per second, according to Peterson.

Albert Yu, senior vice president and general manager at Intel, says many people are missing a key area where the PowerPC players are behind: notebooks. "We believe Pentium notebooks will be standard and very cheap by the end of this year, with DX4s falling to the low end. At the same time, the PowerPC notebook effort hasn't come to anything." Phil Pompa, director of marketing for Motorola's RISC processor division, responds that PowerPC notebooks are set to arrive in volume, with three as-yet-unannounced portables set to ship later this year.

Much of the success the PowerPC players could enjoy this year depends on IBM, which is now working on a notebook based on the PowerPC 603e. In a move that could give a big boost to Microsoft Windows NT for PowerPC, though, IBM has conceded that it will not ship a final version of its OS/2 for PowerPC with its June desktops. IBM is planning, however, to ship a beta version of OS/2 for PowerPC with the desktop systems.—*Sebastian Rupley*

Apple and IBM Finally Agree

The PowerPC Common Hardware Reference Platform is designed to run both PC and Macintosh operating systems.



showing the Common Hardware Reference Platform (CHRP) designed to run both PC and Macintosh operating systems. IBM plans to ship its first PowerPC-based desktop systems in June and its own Warp for PowerPC later this year. And Microsoft plans to ship Windows NT for PowerPC in June.

identity has irrevocably set the PowerPC platform back," says Don Peterson, president of DeskStation Technologies in Lenexa, Kansas, which makes high-end RISC workstations. Peterson likes other RISC processors better than the upcoming PowerPC 620 chip (a competitor of Intel's

License to Browse: Mosaic vs. Netscape

THE BATTLE BETWEEN THE TWO most popular Web browsers—NCSA Mosaic and Netscape Navigator—is heating up at the licensing level as hardware manufacturers and software publishers are chomping

evaluation, but Navigator is much like a shareware product in its approach to end-user licensing.

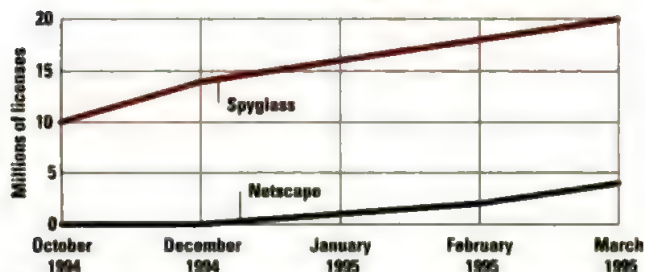
Corporate end-user licensing for Netscape Navigator starts at \$39 per unit and

operates on a sliding scale. Like Spyglass, however, Netscape offers the browser and its technology to manufacturers and for in-product licensing. According to Rosanne Siino of Netscape, new licensees include Silicon Graphics; Digital Equipment Corp.; MCI, which is customizing the interface for InternetMCI; and Delphi. Recently,

Novell licensed the browser for inclusion in WordPerfect Internet Publisher. Netscape has also entered into an alliance with Adobe and will bundle Adobe's Acrobat software with its browser technology.—Neil Randall

The Licensing Race Heats Up

The recent license of Spyglass's Enhanced NCSA Mosaic with Microsoft could double or triple the number of licenses by the end of 1996. Meanwhile, the inclusion of Netscape Navigator in WordPerfect for Windows and InternetMCI is expected to boost the number of Netscape licenses.



Note: November data was not available

Source: Netscape Communications Corp. and Spyglass Inc.

ing at the bit to include Web client technology in their products. But there's no consensus on which of the two standards to adopt.

Mosaic, developed by the National Center for Supercomputing Applications at the University of Illinois, comes with an unusual licensing agreement. A master licensing agreement between NCSA and Spyglass means NCSA doesn't handle requests for licenses. In 1994, Spyglass developed Enhanced NCSA Mosaic (a modified version of the Mosaic found free on the Net) and now licenses it to software publishers, hardware manufacturers, and book publishers.

You can find Enhanced Mosaic technology in such products as Spry's Air Mosaic (Spry has recently been acquired by CompuServe), Luckman Interactive's Super Mosaic, and Quarterdeck's Qmosaic, as well as in hardware from Digital Equipment Corp. and in books from publishers such as O'Reilly & Associates and Ventana Press.

A recent major addition to Spyglass's stable is Microsoft, which has licensed Enhanced Mosaic for Windows 95. But Microsoft hasn't yet made clear whether or in what form Enhanced Mosaic might appear.

Unlike NCSA, Netscape Communications Corp. freely licenses the Web browser it developed. Netscape Navigator has overtaken the FTP version of NCSA Mosaic as the most frequently used "free" browser on the Web, but—strictly speaking—it's not a free product. Educational licenses are free, and anyone can download the software for

Top Retail Software

Current ranking	Last issue	Product, company
1	—	Norton Anti-Virus 3.0 Symantec Corp.
2	—	CompuServe Value Pack CompuServe Information Services Inc.
3	1	MS-DOS 6.22 Upgrade Microsoft Corp.
4	6	WordPerfect 6.1 for Windows Upgrade Novell
5	—	WinFax PRO 4.0 Delrina Technology
6	5	Procomm Plus for Windows 2.1 Datastorm
7	—	MS Works 3.0 with Money 3.0 Microsoft Corp.
8	—	CorelGallery 1.0 Corel Corp.
9	10	WordPerfect 6.1 for Windows Novell
10	3	QEMM 7.5 Quarterdeck Office Systems

This list ranks PC business programs according to the total number of copies shipped to over 12,000 stores and resellers in the week ending March 25, 1995; the list cannot be interpreted as a picture of the entire software market. Adapted from a compilation by Ingram Micro.

Packaging the Net

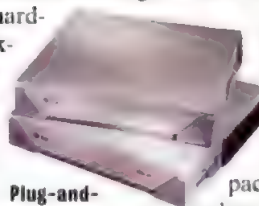
SUDDENLY, INTERNET-IN-A-BOX IS a phrase with new meaning. Growing recognition among network administrators of the need for Unix workstations as the crucial link between LANs and the Internet is creating a big market for Internet hardware. All of the major workstation manufacturers have begun packaging their machines as turnkey solutions to connecting to the Net, and some—such as Silicon Graphics with its WebForce servers—have begun to offer all-in-one, World-Wide Web servers as well.

Sun Microsystems' Netra Internet Server is designed explicitly to connect LANs to the Internet, and comes in both a workgroup version (for about 10 to 50 users) and a departmental version for larger groups. Running either the microSPARC-II or the SuperSPARC processor and Sun's Solaris 2.4 operating system, these servers offer a full suite of Internet software. Most impor-

tantly, they're designed to be completely plug-and-play solutions.

According to Maneesh Dhir, senior product manager at Sun, the Netra is aimed at smaller organizations. "We assume minimal Unix knowledge," he says. "Everybody wants to get on the Internet, but businesses don't always want to go out and hire a system administrator. You might have Unix-savvy people at HQ, but in your branch offices you might not. The Netra lets these offices reach the Net easily, as well."

Sun appears to be ahead of the pack, but other workstation makers have taken notice of turnkey Internet hardware. Digital Equipment Corp., for instance, offers the Internet AlphaServer 200. Designed for connectivity through modems and LANs, the server comes stocked with software, including FTP, Telnet, Lnx, Wis, Ping, and Pine. DEC's higher-end servers also ship with Netscape's NetSite server software. DEC is also offering Electronic Locker, which "looks like Mosaic, and which nonexperts can use to automate the creation of user accounts and to track disk quotas and performance."—Neil Randall



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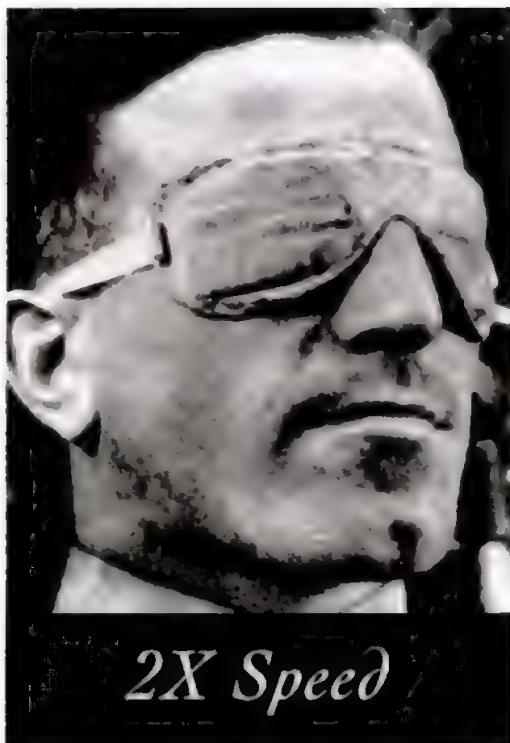
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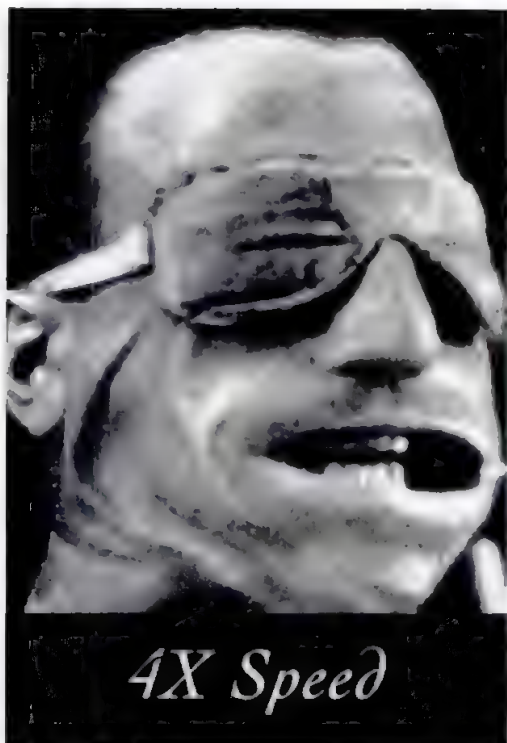
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First Looks

HANDS-ON REVIEWS OF NEW SHIPPING PRODUCTS

PCs

Compaq's Latest Deskpro Goes Slow But Speeds Up Network Management

By Carol Venezia

Compaq Computer Corp.'s recently redesigned Deskpro PCs aim to deliver what could be considered a corporate computer buyer's dream machine: an affordable, network-ready Windows powerhouse that is easy to service, won't be technologically obsolete in a week, and won't cost a fortune to maintain. For the most part, the Deskpro 5100 Model 720/W that we tested does live up to its family credo.

Priced at \$3,778 (estimated street price), this Pentium/100-powered PC is built around Compaq's TriFlex/PCI architecture, which employs a passive backplane design that allows for easy access to the system's components. It also comes standard with an integrated, bus-mastering PCI Ethernet controller.

A WELL-CONNECTED PC

To address the issue of the costs involved in owning and managing

networked PCs, Compaq has introduced what it calls "Intelligent Manageability." All new Deskpros now include a collection of system management tools as well as hardware and firmware enhancements that bring many of the aspects of the company's server-management technology to the desktop (see the sidebar "Network Management Made Easier").

The Deskpro 5100 comes with an extensive set of software utilities designed to simplify the process of tracking and monitoring system hardware and software. The backbone of this scheme is Compaq's Diagnostics for Windows, which provides information on hardware and software components installed in the system. This utility is the local component of Intelligent Manageability's AssetControl feature

(which provides much of the same inventory-centric information remotely over a network through supported third-party management packages). The Network Setup Utility includes network client drivers so users can configure their systems to run under NetWare, LAN Manager, Vines TCP/IP, WFWG, and LANTastic.

Deskpro 5100 systems are available in either desktop or mini-tower configurations. Our test system was housed in a mini-tower case, which provided adequate space for expansion with

three front-accessible 5.25-inch drive bays and two internal bays. The Deskpro does not include a CD-ROM drive as standard equipment; this option is priced at \$249 for a quad-speed model. The two internal bays were utilized by a Quantum 724MB Enhanced IDE hard disk (a 1GB disk is also available) and



DESKPRO 5100: Compaq's latest Deskpro is ready to plug into a network.

a 3.5-inch floppy disk drive.

This system's mini-tower case fulfills Compaq's promise of easy serviceability. The sides of the

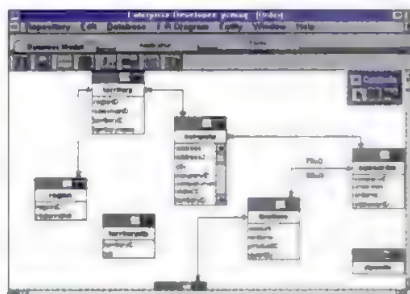
Continues on page 38

APPLICATION DEVELOPMENT

PowerBuilder or Enterprise Developer: Speed Versus Grace

By Brian Butler and Mark Childers

As judged by the multitude of new or upgraded programs recently appearing on the market, few areas are hotter than client/server development tools. Two of the newest, Powersoft's PowerBuilder Enterprise 4.0 and Symantec's Enterprise Developer 2.0, each approach the development process from a different angle but yield full-fledged Windows-based applications. While Enterprise Developer's core architecture is graceful, alluring, and provides a quicker development route than PowerBuilder's more traditional design, this comes at the expense of a gener-



CONNECT: Enterprise Developer lets applications be built by connecting boxes.

ally less mature environment and applications that aren't as fast.

Architecturally the more interesting of the two, Enterprise Developer can best be described as the mating of a CASE tool with

an object-oriented 4GL development environment. The architecture isolates the physical data source, business model, transaction optimization, and front-end application into separate layers that can be worked with independently. Symantec calls this approach SCALE, for scaleable architecture for large enterprises.

SCALE lends itself to a methodical design process rather than hashing out lines of object-oriented application code. During evaluation, we spent a lot of time up front laying out

the database and entering the business rules. Once established, the application almost builds itself. Because the business rules are stored centrally, the develop-

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Compaq Deskpro

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case are removable via thumbscrews. On one side, you'll find the system board, also removable for easy servicing by loosening three thumbscrews. The system board has six SIMM banks, for a total memory capacity of 192MB.

This board also integrates Compaq's QVision 1280/P graphics controller with 1MB VRAM (upgradable to 2MB); and Compaq's NetFlex ENET/PCI 32-bit bus-mastering Ethernet controller, which provides both RJ-45 and AUI connectors. An IBM ISA Auto 16/4 Token-Ring controller is available as a preinstalled option.

On the other side of the case is the Deskpro's TriFlex/PCI backplane. This board provides three ISA expansion slots, one PCI slot, and one shared ISA/PCI slot, all of which were free in our test system. Also located on this board are connectors for CD-ROM, hard disk, and floppy disk drives.

COMPAQ FALLS BEHIND

The Deskpro 5100, though a competent performer, didn't excel on our Windows-based benchmark tests when compared with other Pentium/100-based units we've tested. Its Winstone score of 124 fell short of the average Pentium/100's score of 152. On our Disk WinMark 95 tests, the Compaq unit's score was about half the Pentium/100 average (see "Tapping the Promise of Pentium").

The major reason the Deskpro 5100 was unable to keep up with the average Pentium/100 system was that it was running Windows 3.1, as opposed to most of the other Pentium/100s, which used Windows for Workgroups. These systems were able to take advantage of WfWG's 32-bit file cache,

According to a recent study conducted by the Gartner Group, the total five-year cost of owning a corporate PC running Windows 3.1 is \$40,000: ten times the average purchase price. So what can businesses do today to simplify the task of maintaining a networked PC? Compaq's solution to this problem is Intelligent Manageability.

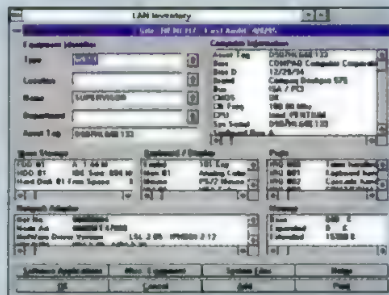
Although many of the following features are available from network management packages, Compaq is the first to integrate them all together in one box.

THE INTELLIGENT CONNECTION

Intelligent Manageability (IM) aims to make networked PCs easier to manage. Although most of IM's features that are now available on Compaq's new line of Deskpro systems are locally accessible, remote access requires the use of a third-party network-management package. Compaq has teamed up with major network-management software vendors to provide remote access for IM features today. Once Windows 95 ships, however, remote support will be possible through Insight Manager, Compaq's server management software.

AssetControl is a software utility that allows network administrators to monitor and inventory all installed system hardware and software. Information is available locally through Compaq's Diagnostics for Windows. With Windows 95, AssetControl will work in conjunction with Insight Manager to provide information over the network. In the interim, you must use a third-party management package to collect and view system

Network Management Made Easier



SYSTEM MONITOR: Compaq's Intelligent Manageability allows remote diagnostics.

data remotely.

The Fault Management aspects of IM fall into two categories: Fault Prevention and Rapid Recovery. Fault Prevention features include Compaq's new IntelliSafe Hard Drive technology, which, through firmware enhancements, provides early-warning notification of impending disk failure and a prefailure warranty; Environmental Fault Pre-

vention, which tracks internal PC temperature; and Network Performance Monitoring, which monitors NIC performance data (note that the latter two features require Windows 95).

Rapid Recovery features, all of which require Windows 95, include Proactive Tape Backup, which automatically backs up hard disk information to your server's tape drive when a disk failure is detected; and Flash ROM BIOS, which allows administrators to perform BIOS updates remotely.

To test IM's features remotely, we attached the Deskpro 5100, as well as a ProLinea 4/33, to a Deskpro 486/33M server running NetWare 3.12. Utilizing McAfee's LAN Inventory 3.2, we were able to view system information on all three machines from the ProLinea client workstation. The Deskpro 5100's configuration was available locally through AssetControl, which provides an API for LAN Inventory to read system information.

The problem is one of interactivity, because the Deskpro shows static information derived from startup. When we disconnected the floppy disk controller, we had to reboot the machine for the change to be recognized.—CV

when used in conjunction with

pipeline-burst SRAM and extended data-out memory—effectively boosts performance. Compaq has traditionally engineered its own chip sets, and the new Deskpros are no exception.

The Deskpro 5100 provides a comprehensive package of hardware and software components that work together to give users and network administrators a system that's easy to use, easy to monitor, and easy to maintain. It may be a bit pricier and slower than the average Pentium/100-based PC, but its forward-looking design may actually save a few dollars over the life of the system. **Compaq Deskpro 5100 Model 720/W.** Estimated street price: With Pentium/100 CPU, 16MB RAM, 724MB hard disk, 15-inch monitor, \$3,778. Compaq Computer Corp., Houston, TX: 800-345-1518; fax, 713-378-1442.

Circle 428 on reader service card

BENCHMARK TESTS



Compaq Deskpro 5100

The Compaq Deskpro 5100 turned in rather disappointing test scores when compared with other Pentium/100s (see this issue's story "Tapping the Promise of the Pentium"). Its slower performance may be because it runs Windows 3.1 instead of

the more popular Windows for Workgroups, which has a 32-bit file cache.

We used WinBench 95, Version 1.0, and PC Bench, Version 9.0, to gauge the performance of this desktop PC. The system was equipped with 16MB of RAM and 256K of external cache.

Higher scores represent better performance	Winstone 95	Graphics WinMark 95 (Mpixels/sec)	Disk WinMark 95	DOSMark	CPUMark ₉₉	DOS Video	DOS Disk
Compaq Deskpro 5100	124	13.9	413	982	216	2,866	747
Pentium/100 average (reviewed in this issue)	152	14.4	743	1,009	212	4,445	711

First Looks

Application Development

Continued from page 37

er can quickly change a discount given to selected customers, for instance, without having to unravel large portions of the application.

By contrast, PowerBuilder takes a more traditional 4GL approach to development, in which business rules are mostly hard-coded and embedded within the application code itself. PowerBuilder's strength is its highly evolved and productive development environment, which includes a robust scripting language and several powerful GUI programming tools, as well as strong reporting skills and business graphics.

WINDOWS ON YOUR DATA

PowerBuilder's DataWindows are most improved. A DataWindow is a data-aware control that has been highly optimized for handling the flow of data in and out of an application. They are not only key for application development, they are also central to the reporting aspects of the product. Version 4.0's DataWindow creation process is new, and it makes these versatile windows easier to use. You can also embed a DataWindow within another DataWindow, which lets you display subordinate data for each record without complex grouping and ordering by clauses.

Another strength of PowerBuilder is its full-featured reporting capabilities. In this release, a cross-tabulation generation dialog box has been added that allows users to create a report using drag-and-drop functionality. This feature can also be called up from a runtime module to let the end user

modify an existing cross-tab report or generate a new one. In comparison, PowerBuilder's cross-tab abilities are part of the program's spreadsheet control and are harder to learn and use.

PowerBuilder 4.0 applications support OLE 2.0 as a container and for in-place automation, while Enterprise Developer 2.0 applications support only OLE

1.0. Both products allow you to embed OLE objects in a form and relate them to a BLOB (binary large object)-type database column, but Enterprise Developer is limited to a maximum object size of 32K.

TEAM DEVELOPMENT

Team programming is handled similarly in these products. Both have a library with basic check-in and check-out functions, and Enterprise Developer adds an extra

integrity, SCALE will take advantage of that feature or will emulate it.

New is Enterprise Developer's Trigger Express, which allows you to generate server-based code to enforce business rules. Enterprise Developer applications still take advantage of the repository to enforce business rules, which provides a layer of isolation from the back-end database server. This provides the best of both worlds: isolation from

application, and that's where Symantec has focused its optimization efforts. Programmers implemented caching of the repository at runtime to allow forms and reports to be displayed more quickly. The SCALE datalinks have also been optimized to improve transaction processing. However, performance remains the product's greatest weakness.

In informal testing, we found PowerBuilder 4.0 to be faster than both Version 3.0 and the present release of Enterprise Developer. PowerBuilder 4.0 completed 50,000 loop operations in 5 seconds (compared with Version 3.0's time of 13 seconds), versus Enterprise Developer's time of 81 seconds. We also looked at the raw retrieval rate of each product by timing how long it took to retrieve (with no *where* clause) 25,000 rows from a SQL Server database. Here both Versions 3.0 and 4.0 came in at around 30 seconds, while Enterprise Developer pulled up the rear with a time of almost 4 minutes.

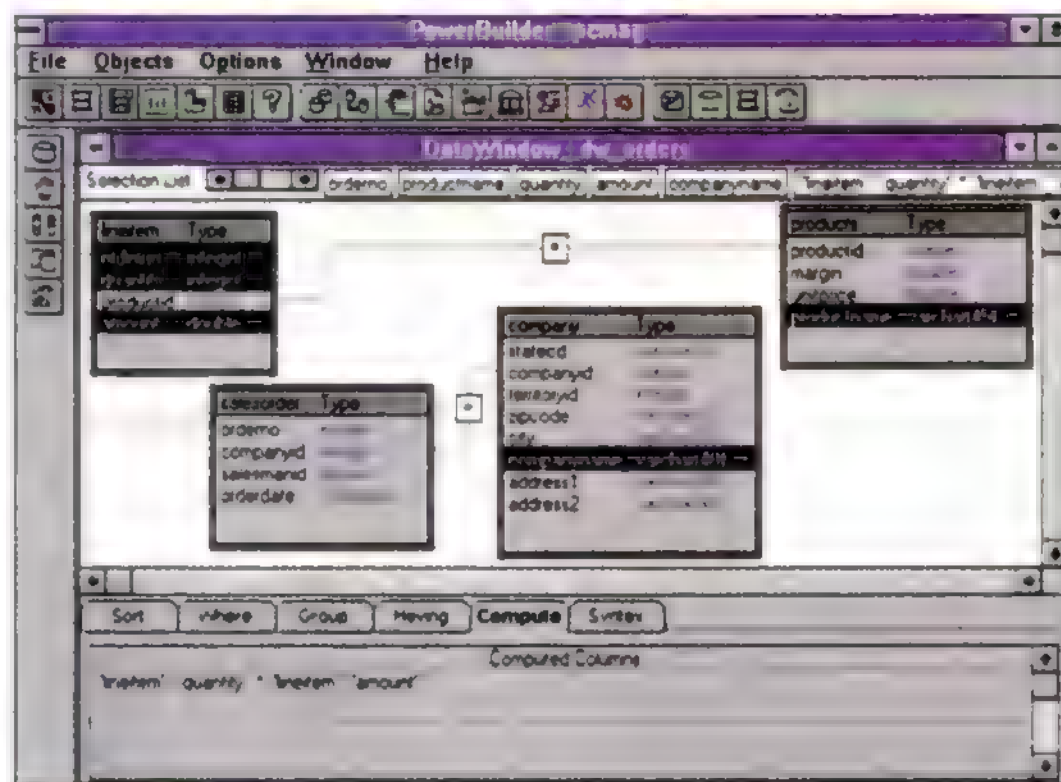
All told, Team Enterprise Developer has a compelling architecture, and it ironically makes the most sense in the small- to medium-size installation, because the product still lacks the polish and maturity of PowerBuilder and other development environments. PowerBuilder 4.0 is a welcome upgrade that includes significant performance enhancements, a polishing of the already rich feature set, and 32-bit client support. PowerBuilder stays at the head of the client-server pack, but watch out: Enterprise Developer and others are catching up quickly.

PowerBuilder Enterprise 4.0. List price: \$3,295. Requires: 18MB RAM, 19MB hard disk space, Microsoft Windows 3.1 or later. Powersoft Corp., Concord, MA; 800-395-3525, 508-287-1500; fax, 508-369-5071.

Circle 431 on reader service card.

Team Enterprise Developer 2.0. List price: \$3,295. Requires: 12MB RAM, 18MB of hard disk space, Microsoft Windows 3.1 or later. Symantec, Cupertino, CA; 800-488-9914, 503-334-6054; fax, 408-252-4696.

Circle 432 on reader service card.



INS AND OUTS: PowerBuilder's DataWindow serves as the entrance and exit for an application's information.

level of development security through its repository, where you can limit rights in a development team.

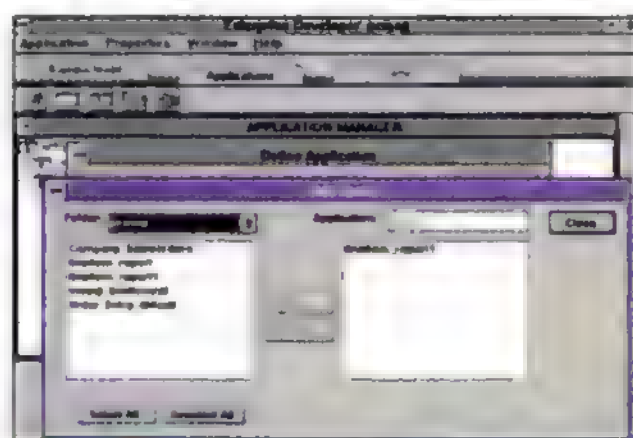
These new releases attempt to cast as wide a net as possible in

database semantics and enforcement of data integrity even outside your Enterprise Developer application. The program's Database Migration Express lets the developer move an entire database or a simple table—including data, indexes, and keys—from one database to another. The only items not transferred are triggers and stored procedures.

PowerBuilder has what Powersoft calls the Data Pipeline, which is similar to Enterprise Developer's Data Migration Express but seems to be aimed at the requirements of data warehousing. For example, when running a PowerBuilder application against a local server entering or editing data, a data pipeline object can be executed to transfer data from the local server to a main server.

CENTER OF OPERATIONS

Each product takes a different tack as far as optimization is concerned. The repository is central to every Enterprise Developer



BY THE BOOK: Enterprise Developer isolates the business rules from the data.

terms of databases. Enterprise Developer's SCALE allows the application to be independent of a particular back-end database. Unlike ODBC, the SCALE architecture allows you to take advantage of the various strengths of the database when they are available. For instance, we found that if the database back-end supports declarative referential in-

PORTABLE PCS

Innova Book: If Screen Size Matters More than Performance

By Asa Somers

In a word: It's *big*. We're talking about the first 11.3-inch notebook computer screen, featured in the \$3,199 Canon Innova Book 200LS.

While it's only about 18 percent larger than a 10.4-inch screen, the margin is enough to elicit a chorus of oohs and ahs for its superior size—and of too bads from passersby. The oohs and ahs because it truly looks large, and the too bads because the dual-scan passive-matrix display fails to light up the screen in brilliant colors.

Our immediate impression of the sleek Innova Book 200LS (7 pounds 8 ounces, 1.8 by 11.9 by 9.4 inches) was positive. It has a large, comfortable palm rest; a sturdy, full-size keyboard with a built-in pointing stick; and two stereo speakers located under the screen.

The 200LS model we tested, which comes with a DX4/100 CPU and a 520MB removable hard disk, yielded mixed results on our tests, however. In terms of DOS performance, what began as an above-average CPUMark₁₆ score of 75 faltered due to substandard disk and video performance, resulting in a DOSMark of 345, well below the notebook average of 405.

Windows performance was better. The Innova Book turned in above-average Winstone 95 (53.7) and Graphics WinMark 95 (3.8 million pixels per second) scores. The biggest disappointment was the system's prodigious power consumption, resulting in a WinDrain result of about 90 minutes for the battery's capacity.

We noticed some banding and perceptible inconsistency in brightness and contrast near the edges of the Innova Book's Samsung-made screen. More important, the colors weren't especially rich, and images appeared washed-out at times. We were able to use the Innova Book's intuitive display controls to cus-

tomize the screen settings to suit ambient lighting conditions, which improved the situation somewhat. Users accustomed to active-matrix color displays will definitely miss the crisp, saturated images, despite the size differential.

The Innova Book contains a number of usability features that add up to an impressive overall design. Typing is made even more comfortable with snap-out legs for

tilting the computer. An internal floppy disk drive comes standard, as does a built-in microphone and 16-bit Sound Blaster-compatible sound. You can remove the nickel hydride battery and hard disk in a snap, and the Type III PCMCIA slot (which accommodates 2 Type II cards) and all the ports are easily accessible.

If you can sacrifice rich color for a wider window on the world, Canon's Innova Book, with its wealth of features and reasonable price tag, might be what you're looking for.

Canon Innova Book 200LS. Estimated street price: with DX4/100 CPU, 8MB RAM, and 520MB hard disk, \$3,199. Canon Computer

Systems Inc., Costa Mesa, CA; 800-848-4123, 714-438-3000; fax, 714-438-3099.

Circle 424 on reader service card



BIG SCREEN: Canon's Innova Book brings the first 11.3-inch display to the notebook arena.

PORTABLE PCS

Tadpole Pentium Is the Only Fish in the 100-MHz Pond

By Melissa J. Perenson

The Tadpole P1000 notebook from Tadpole Technologies makes great strides toward closing the gap between desktop and mobile computing. In its first PC platform venture, Tadpole has put together a package to be reckoned with. But with an \$8,995 price tag, the Tadpole P1000 we tested is aimed at those who can

Blaster-compatible sound, a stereo headphone jack, and a built-in speaker and microphone. The system is rounded out with a 10.4-inch active-matrix color screen and a Type III PCMCIA slot.

The crisp active matrix display is particularly easy on the eyes. The sturdy, roomy Lexmark keyboard with an integrated pointer is one of the more comfortable laptop keyboards we've used. The hard disk, manufactured by IBM, is simple to remove. And there's an LCD status display conveniently located in the center of the machine that provides crucial, if cryptic, information on the status of the machine.

Finally, the Tadpole is in a class by itself for allowing the use of operating systems that run the gamut from DOS and Windows to Solaris x86/PC Unix and Windows NT.

The machine's overall performance was stellar for a notebook but still a notch below a Pentium desktop PC. The Tadpole had an impressive Winstone score of 97.7, and a high Graphics WinMark score of 7.3 million pixels per second. Don't count on wandering far from an outlet, though. Our WinDrain battery test shows that the Tadpole's NiMH battery lasts just 53 minutes on a charge—

barely enough time to run through one presentation.

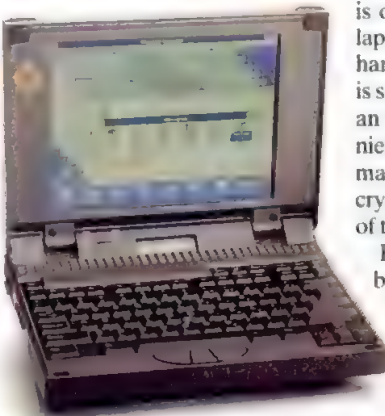
Be prepared to make a major sacrifice to attain this level of performance in a relatively small package. This 11.8- by 8.5- by 2.0-inch notebook has a travel weight of 9 pounds with the battery, external floppy disk drive, and power adapter; the system and battery weigh in at 7 pounds 5 ounces. Tadpole sells an optional 4-pound external battery that could double your time away from the wall outlet but brings the travel weight to over 13 pounds.

The Tadpole is a hot machine figuratively, but surprisingly, not literally. The processor is positioned so that its excess heat is dissipated through the system's underside, making the case part of the system's thermally innovative heat sink. Even after several hours of usage, the unit maintained a tepid temperature.

The Tadpole P1000's Pentium-aided performance is as impressive as it is expensive. It isn't for everyone, however.

Tadpole P1000. List Price: with Pentium/100 CPU, 16MB RAM, 256K cache, 810MB hard disk, 10.4-inch active color display, \$8,995. Tadpole Technology Inc., Austin, TX. 800-232-6656, 512-219-2200; fax, 512-219-2222.

Circle 423 on reader service card



FAST FISH: The Tadpole P1000 packs a 100-MHz Pentium punch.

afford this combination of power and portability.

Built around Intel's 100-MHz Pentium processor, the Tadpole's spec sheet reads more like a desktop PC: 16MB RAM, upgradable to 128MB, 256K cache, an 810MB hard disk, PCI bus, 1MB VRAM, 16-bit stereo Sound

New Close-Up Offers Fastest Remote Windows Speed

Fastest Modem Communications

Now Close-Up, two-time winner of PC Magazine "Editors' Choice" award for remote communications software, has a brand new version that lets you view & control other PCs by modem — just as if you were there!

"Version 5.0 Close-Up was fast, but Version 6.0 has even better Windows performance and added features to keep it ahead of the pack."

— PC Magazine, July 1994

Why Is Close-Up So Fast?

Close-Up learns as it works. It uses AI (Artificial Intelligence) to compress all Windows video function calls. That's why Close-Up does so well in Windows Benchmark tests (see WinBench 95 chart).

Close-Up uses its revolutionary Photographic Memory™ so that once Close-Up has seen all or part of a Windows screen, it's memorized. Then as screens change, Close-Up only transmits new unmemorized data. Incredibly, with this technology Close-Up gets faster & faster the longer you use it.

Expert System Makes Communications Easy

You don't have to be a communications expert to get the results of one. Close-Up has an Expert System that automatically analyzes system components and configures your system for maximum speed.

WinBench™ 95 Ver 1.0 by Ziff-Davis Labs Tests Remote Windows™ Speed

The graph on the right shows the speed of the three leading remote control programs when transferring Windows screens. As you can see, Close-Up handles more pixels faster, meaning you spend less time waiting for Windows screens to transfer.

WinBench scores
(average of 10 runs):

Close-Up	209,270
pcAnywhere	122,600
Reachout	101,900

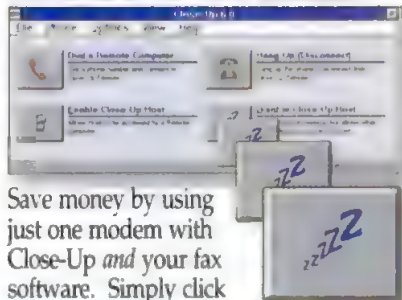
WINDOWS & DOS

Close-Up saves time & money by allowing you to connect between PCs running DOS or Windows, eliminating the need to switch between products when connecting to different PCs.

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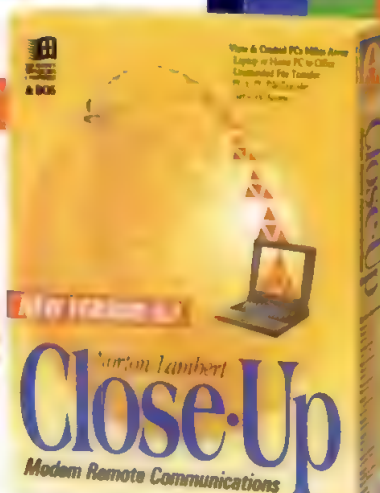
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**COMPETITIVE
\$69.95
UPGRADE**



We invite you to reproduce this test. Modems: Hayes OPTIMA 288 V.FC. Computer (Host) Gateway, (Remote) Micron, Pentiums 90Mhz, 32MB RAM, 128KB RAM cache, 500MB HD, IDE controller, no hardware disk cache. Video: (Host) STB Lightspeed 1MB VRAM, (Remote) Diamond Stealth 64 2MB VRAM, 800 x 600 pixels, 16 colors, SuperVGA DRV 11/1/93 75 Hz, MS-DOS 6.22, SMARTDRV 2MB cache. WinBench 95 is available on ZiffNet via CompuServe. All products are shipping versions. Test performed without verification by Ziff WinBench trademark of Ziff-Davis Publishing Co. Windows trademark of Microsoft Corp. *60 day money-back guarantee if purchased directly from Norton-Lambert. Offer expires 9/30/95. All prices in US Dollars. Prices exclude shipping. © 1995 Norton-Lambert Corp.

CIRCLE 346 ON READER SERVICE CARD

pixels
per
second

200,000

150,000

100,000

50,000

0

Close-Up

pcAnywhere
for Windows 2.0

Reachout

FONTS

Typestry 2 Gives Type Depth, Texture, and Movement

By Edward Mendelson

Typestry 2 has the power to transform a series of characters into high-tech three-dimensional images and animations. Unlike rival 3-D graphics programs such as RayDream's \$349 Designer 3 or Caligari's \$795 TrueSpace, Pixar's \$299 package is designed to work almost entirely with type, although you can also import simple shapes from Adobe Illustrator. Compared with these general-purpose packages, Typestry 2 suffers from an antiquated interface.

To use Typestry, you start by typing a text string in any Windows font. After selecting this text object, you extrude the characters to give them depth and bevels, light them with customized spotlights, add surface textures, and put a floor and wall in the background. While somewhat unintuitive, Typestry's tools let you ro-

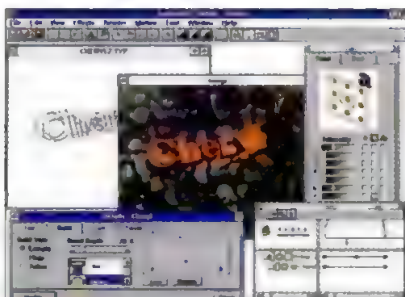
tate and skew the text.

To create an animation, you place the text object—or separate letters in the object—in the positions you want them to appear in at different frames in the anima-

lets you determine whether different parts of an object will move together or separately. Animations can include wind blur and particles that explode from the surface of a text object.

The program produces dazzling results with minimal effort and training, but Typestry's interface is awkward. Unlike RayDream Designer and TrueSpace, Typestry won't let you work with lights, walls, floors, and colors in the same window that you use for manipulating the size and shape of your text. Text is manipulated in a bare-bones wireframe window, while sepa-

rate windows let you select colors, position lights, and create walls and floors. You can't see how these features fit together until you render



WIREFRAME: Typestry 2 requires that you work with a wireframe image while editing. You have to render to see any details.

tion sequence. The program interpolates images that show the object moving from one position to another. A "score" window

an image, so complex effects require a lot of trial-and-error.

Typestry 2 comes with the Win32s extensions needed to run the program under Windows 3.1 or Windows for Workgroups, but it runs more reliably under Windows NT. Even under Windows NT, it crashes when it can't render one of its own exploding-particle effects, and you won't know what happened unless you turn on the option that displays messages about the program's operations.

Despite these headaches, Typestry 2 provides a uniquely well-equipped desktop studio for creating three-dimensional animated type. If you want to see how your words can move around the screen, nothing else gives it to you so economically.

Pixar Typestry 2. List price: \$299. Requires: 8MB RAM, 7MB hard disk space, Microsoft Windows 3.11 with Win 32s or Microsoft Windows NT. Pixar Inc., Richmond, CA; 800-888-9856, 510-236-4000; fax, 510-236-0388.

Circle 403 on reader service card

WINDOWS GRAPHICS

Paint Shop Pro 3.0: The Complete Image Studio

By J.W. Olsen

With Version 3.0 of Paint Shop Pro, JASC puts everything together, producing a complete PC suite for paint and photo retouching. Extended functionality, a coordinated image browser, compelling ease of use, and a \$69 price tag make Paint Shop Pro shine.

To alter or enhance images, you begin by loading them directly from disk, capturing screen shots, or using the PSP Browser module. PSP 3.0 adds 11 supported file formats, for a total of 31, which cover all common graphic types. In addition, PSP now supports the Aldus/Micro-soft import filter interface, so you can

transparently extend PSP to products such as PageMaker or Word.

Paint Shop Pro's image-enhancement features are vastly improved. Its color replacement functions are a delight to use. You can apply this feature to an image or selected area, or even globally to multiple images. Paint Shop Pro now quickly previews effects and supports plug-in filters, including those for Kai's Power Tools.

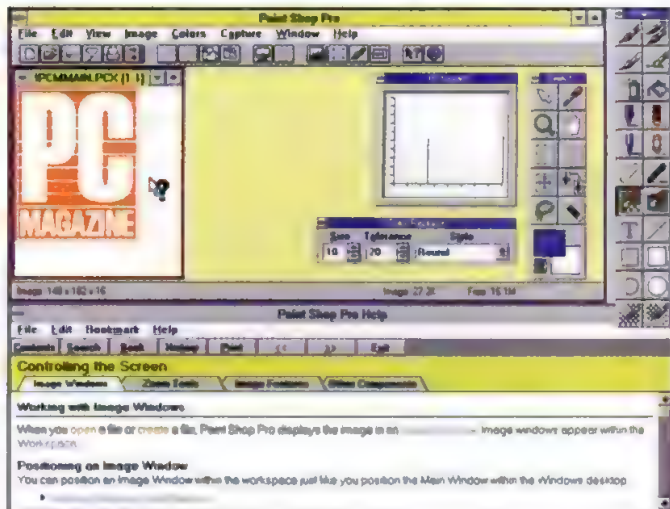
The painting tools are versatile, with eight standard brushes (pen, pencil, marker, crayon, chalk, charcoal, air brush, and paintbrush) and a user-definable brush for creating customized effects. Photo-retouching tools cover the usual bases, including a clone tool, an eye dropper to pick up and analyze an image's color, and a wand to select similar areas for editing.

As with competitors, tool palettes and a histogram can be placed anywhere on the screen or suppressed. But—delightfully—a tool control panel can automati-

cally pop up and stay when you access most functions. For example, the color replacement tool's control panel lets you alter size,

gap left by the absence of image enhancement capabilities. The result is a full-featured graphics editor at a hard-to-beat price.

Paint Shop Pro 3.0. List price: \$69; upgrade, \$230. Requires: 4MB RAM, 4MB hard disk space, Microsoft Windows 3.1 or later.



A HELPING HAND: Paint Shop Pro provides instant access to tools and tips at all times.

tolerance, and style on the fly. Switch functions and the control panel changes accordingly.

Version 3.0 of PSP fills in the

JASC Inc., Minnetonka, MN; 800-622-2793, 612-930-9171; fax, 612-930-9172.

Circle 404 on reader service card



From May 1 to 5, go on-line to download the latest shareware version of Paint Shop Pro 3.0 and discuss the product with John Ort and Robert Voit of JASC, and with reviewer J.W. Olsen. Type GO EXEC at any CompuServe prompt.

RECORDABLE CD!

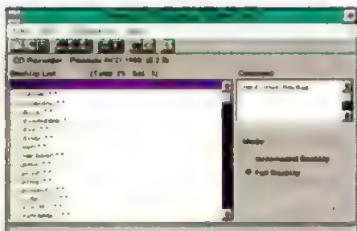
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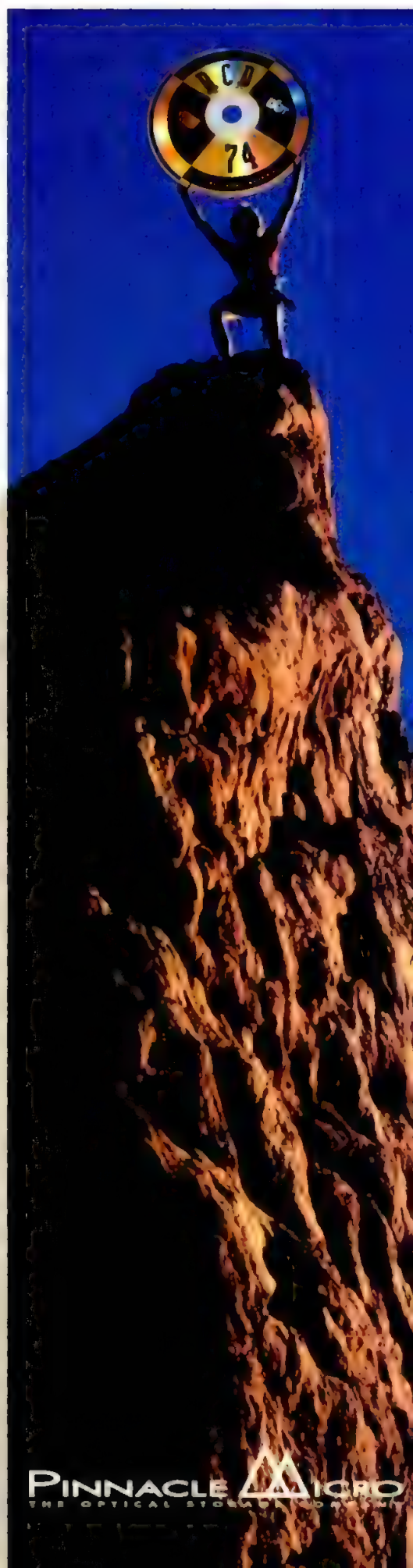
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GRAPHICS

Flo' Treats Digital Images like Clay

By Neil Rubenking

Did you ever press an image into Silly Putty and distort it by pulling at the edges or by squeezing the middle? If so, you've got a good idea of what The Valis Group's \$199 Flo' can do to PC-based digital images.

Make a body thinner without dieting, twist a frown into a smile, raise an eyebrow, or turn a face into a caricature, for example. The creators of Flo' term this technology *Freeform Plasticity*, which is a lot easier to say than the technical description: bicubic subsampling interpolation. Like morphing, freeform plasticity is just plain fun, but also has serious applications in graphic design and animation.

With the four global distortion tools that are included, you can resize an image, rotate it, skew it (that is, turn the rectangular image into a parallelogram), or reshape it with the 4point tool. The 4point tool lets you drag the four corners of the image to new positions, stretching it to fit the resulting quadrilateral.

The most interesting results come from using the local distortion tools: resizing, rotation, skewing, translation (movement), and 4point. Local distortions act on a user-specified region, and their effect is restricted by a specified boundary. For example, you could enlarge a window in a house but restrict the resulting distortion to one wall, making the window appear to bulge from the wall. Along with unlimited undo and redo functions, Flo' offers the welcome ability to redo the current distortion at a specified percentage of its magnitude.

Flo' supports a wide range of image formats, and maintains the quality of the image without introducing any unintended digital artifacts. You can save a .FLO file containing the original image plus all of its distortions, render the final image to one of the many available file formats, or convert a

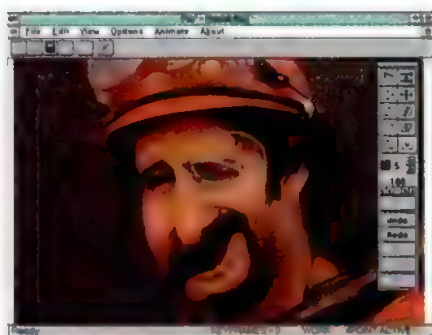
series of distortions into a Video for Windows movie, a FLIC animation file, or a sequence of rendered frames.

To create a movie, all you do is specify a starting frame and one or more keyframes, then take a coffee break while Flo' renders the animation, creating the necessary in-between frames.

Surprisingly, Flo' has no built-in help system. But the program isn't difficult to learn, and the slim manual provides a tutorial on using the various tools. If you plan on using a 386 PC with 4MB RAM, you may be better off with Flo' Lite, which costs \$59 and omits animation.

Look for The Valis Group's revamped Metaflo' and Movieflo' high-end packages later this year, with added features such as morphing during distortion and applying distortions to existing movies. But until then, Flo' will be more than enough to squeeze and stretch your world.

Flo' 1.1. Estimated street price: \$129. Requires: 4MB RAM (8MB recommended), math coprocessor, Microsoft Windows 3.1 or later (with Win32s) or Windows NT. The



MAKE 'EM SMILE: The 4point tool in Flo' can make this guy wink his left eye.

Valis Group, Tiburon, CA; 800-825-4704, 415-435-5404; fax, 415-435-9862.

Circle 401 on reader service card

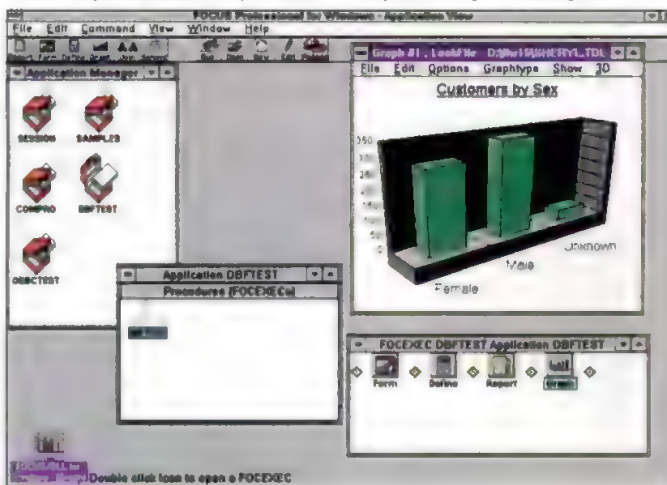
DATABASE FRONT ENDS

Focus on Charts and Reports

By Sheryl Canter

Focus Professional for Windows 1.5 (\$3,495 from Information Builders) is the latest in a series of releases that bring the popular database front-end, PC/Focus, to the Windows platform. Focus makes it easy to create highly customized graphs and reports, and adds a new packager that lets you build freely distrib-

The Report Assistant and Graph Painter let you choose options from within dialog boxes, and the underlying code is generated for you. Click on Run to see your report or graph. The reports or other action items you create (such as file links) can be saved in procedure groups (Focus Executables) and strung together for sequential processing. Control



SEE YOUR DATA: Focus extracts information from a variety of databases.

utable runtime modules.

This release provides a graphical Windows interface for all aspects of PC/Focus except updating, which is performed through an included DLL version of PC/Focus, called Focus/DLL.

The backbone of Focus is a powerful 4GL language, but you don't have to learn this language

and branching is easily handled within the user interface; an object-oriented Forms Painter lets you create dialog boxes for driving your application.

In addition to reports and graphs, Focus procedure groups can contain Define items (which let you create "virtual" fields whose values depend on other

fields in the database), Join items, and other prerreport processing tasks. To create frequency reports or multiway cross-tabulations, simply use the mouse to select additional Sort Fields. Creating graphs is just as easy and many graph styles are supported, including all types of rotatable 3-D graphs.

Focus can directly access Btrieve, DB2/2, dBASE, EDA, FOCUS, Microsoft and Sybase SQL Server, Oracle, and Teradata files; others can be accessed through ODBC. We tested PC/Focus with Focus and dBASE natively, and with FoxPro 2.5 through ODBC. We found the product to perform best with the Focus database. With the dBASE file, a bug prevented us from changing the Y-axis label in a graph. With the ODBC-accessed FoxPro file, attempts to run reports or graphs resulted in a Windows general protection fault.

Focus Professional for Windows includes all the tools needed to create royalty-free runtime executable modules.

Focus Professional for Windows is powerful enough for the most sophisticated user, but the program's Assistants and Painters make it accessible to the new user, as well.

Focus Professional for Windows 1.5. List price: \$3,495. Requires: 8MB RAM, 10MB hard disk space, Microsoft Windows 3.1 or later. Information Builders Inc., New York, NY; 800-969-4636, 212-736-4433; fax, 212-629-8819. Circle 402 on reader service card

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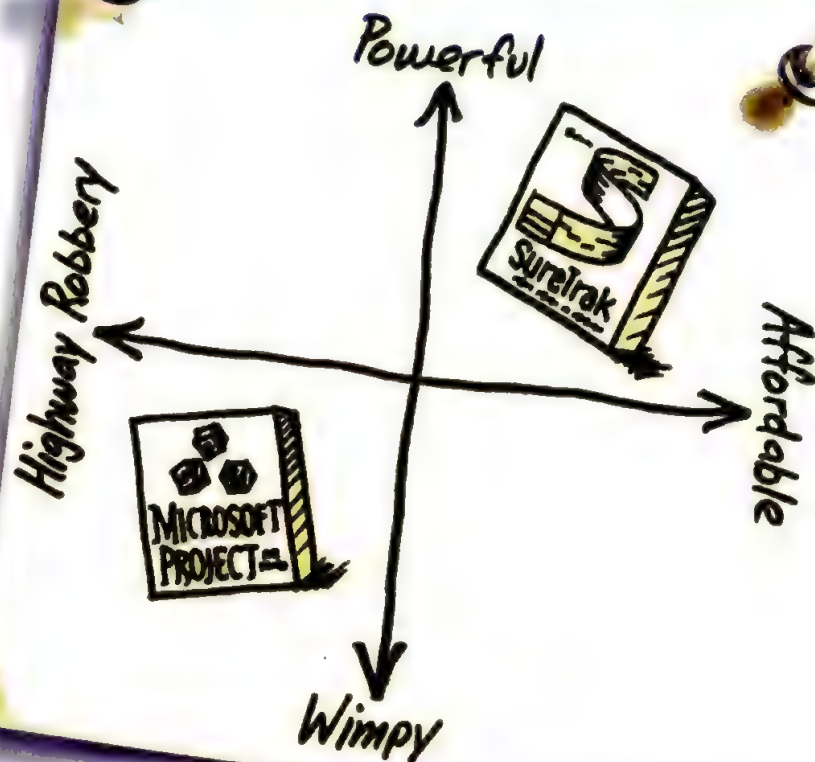
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GROUPWARE

MESA Conference+ Extends Microsoft Mail

By Ben Gottesman

Because of the growing popularity of Lotus Notes, people have become more aware of the value of collaboration and the creative solutions that can come from group discussion. While most of the headlines have been grabbed by Notes, Collabra Share, and Trax Software's TeamTalk, The MESA Group's Conference+ program has quietly established a foothold in the market—with over 100,000 seats installed in less than one year on the market, according to MESA.

Unlike most of the products in this category, which are positioned to provide discussion capabilities in any environment with virtually any mail system, Conference+ (starting at \$1,500 for a 20-user group) is specifically targeting Windows-based Microsoft Mail networks. Whereas the other products require their own client applications, Conference+ works directly inside of the Microsoft Mail Windows client.

Once installed, the program adds itself to Mail's File menu. Users can quickly switch back and forth between their personal mail and Conference+ conferences (MESA's term for discussions), all within the Mail interface.

E-MAIL AND THEN SOME

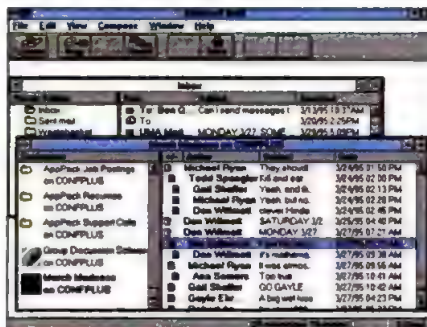
Integrating with Mail has its advantages and disadvantages. Microsoft Mail users will feel at home with Conference+ because its look and feel is so similar to Mail's; you can even use the spell-checker and message finder in Mail.

Because Conference+ uses a message database compliant with MAPI (Messaging API) 1.0, it can be extended in much the same way that Mail can. For example, you can build electronic forms applications with Microsoft's Electronic Forms Designer. This ability lifts Conference+ above most competing discussion products.

Conference+ falls short in its basic conferencing capabilities. Its most serious failing is its inability

to support more than two response levels in a discussion. For example, if one user asks a question, another user responds requesting clarification, and then the first user clarifies, thereafter

supports replication of conferences, making it easy to maintain synchronized copies of a conference across a wide area network or between the network and remote users.



FAMILIAR MAIL CARRIER: Easing the transition, Conference+ discussions occur within the Microsoft Mail client.

no one can answer the question in an organized, threaded fashion. One could argue that this forces quick consensus on an issue, but it could also stifle debate.

Unlike most of its competitors, Conference+ does not support rich text messaging. While messages can contain graphics and OLE objects, discussion participants are limited to a single font. Also, conferences can quickly become difficult to navigate. Users may have trouble quickly accessing new messages in specific areas of interest within a conference. MESA will have a minor upgrade that provides a somewhat streamlined method of navigation around the time you read this.

From the administrator's point of view, Conference+ has plenty of power. The program relies on the same user directory and address book as Microsoft Mail, so defining participants in a conference is familiar and straightforward. On the other hand, the program does not indicate which Mail users are also Conference+ users, so you could inadvertently include network users in a conference who will not be able to participate. The administrator can control whether or not a user can view a conference, submit new messages, and edit and delete existing messages. The program

Although Conference+ is clearly aiming to live in the Microsoft Mail world, MESA has added several additional programs to ease Conference+'s coexistence with other e-mail and discussion products. Like Collabra Share, Conference+ provides a Universal Mail Agent (UMA; \$995 per server), which lets the program exchange messages with

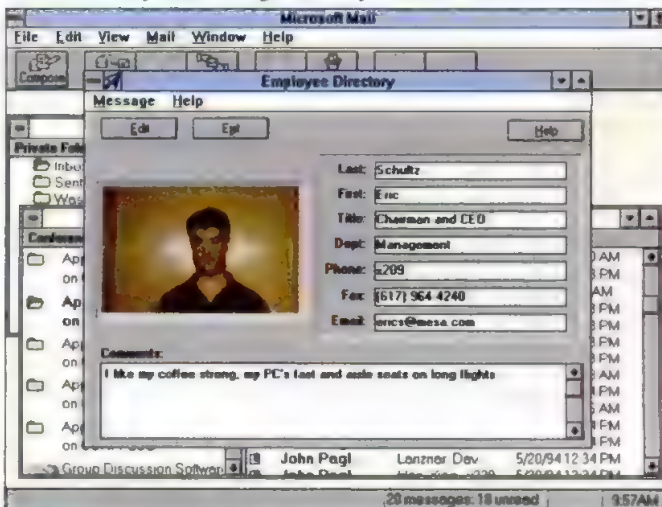
virtually any Microsoft Mail user. This may include those who don't have the Conference+ client software, as well as users of other mail systems accessible via gateways. These users will receive all conference messages as mail messages and can actively participate in the conferences by embedding com-

Connection for Internet News (\$995 for 100 users) runs on a Unix workstation and exchanges messages between Conference+ and designated newsgroups. This allows Conference+ users access to a wealth of information available on the Internet, and at the same time gives the administrator greater control over Internet access.

In addition, MESA Connection for Notes (\$1,495 for 100 users) runs on a Windows server and exchanges messages between Conference+ conferences and Lotus Notes discussion databases. Unfortunately, Conference+'s limitation on response levels and its inability to categorize messages may make these discussions somewhat difficult to follow.

If you have a Microsoft Mail network and are looking to push collaboration, MESA Conference+ is worth the time to evaluate. The program's rudimentary threading capability is balanced by its tight integration with Mail, minimal training costs, and an infrastructure that provides a solid platform for future growth.

MESA Conference+ 1.1b. List price: \$1,500 for 20 users. Requires: Server, 2MB hard disk



INTERACT: Using Visual Basic and Microsoft's Electronic Forms Designer, Conference+ can pull images from a database.

mands in mail sent to the UMA, but will lack the threading capability of Conference+.

NET NEWS

MESA also reaches beyond the Mail realm with two products.

space, Microsoft Mail 3.0 or later; client, 2MB RAM, 2MB hard disk space, Microsoft Windows 3.1 or later. The MESA Group, Newton, MA; 617-964-7400; fax, 617-964-4240.

Circle 422 on reader service card

VIDEO

Snappy Grabs Still Images from Any Video Source

By Neil J. Rubenking

Snappy Video Snapshot, from Play Inc., is the latest must-have PC peripheral for anyone dealing with video and in need of bitmapped images. At \$199.95, this moderately priced hardware/software combination brings video-frame capture within reach of the small-business or home user. For an elaborate screen saver of your favorite television show or an image for a presentation that comes from a company video, Snappy takes video input from a camcorder, a VCR, a TV, or any video source, and it captures true-color (24-bit) digital still images.

Installing the Snappy hardware is simple; you just plug it into a parallel port of your PC, plug your video source into Snappy's video-input connector, and load Snappy's software. The program's user interface is unusual but so easy to grasp that the amusing and well-written manual is almost superfluous.

Once you've connected Snappy, to see the frame you want before actually acquiring it, press the Preview button on Snappy's control panel. A black-and-white preview image of the video input appears on-screen. Then press the Snap button and in one-sixtieth of a second, Snappy grabs a snapshot of the image. Press Save to save the image in a variety of popular formats, including Targa, .TIF, .PCX, JPEG, or Windows bitmap file.

For perfectionists, the Adjust button displays a set of controls that fine-tune the current picture, along with a small color image for previewing changes. Another set of controls linked to the Setup button affects elements of the image-capture process itself, such as the image size (up to 1,500 by 1,125 pixels) and video source.

Snappy's exclusive hardware is the heart of the system. The Play HD-1500 chip oversamples the image eight times to capture high-resolution images in true color. The frame grabber, which is only slightly larger than a cassette tape box, requires a 9-volt battery.



GRAB AND RUN: Snappy (upper right) captures images from a variety of video sources and displays them on a PC. The Adjust interface (bottom) allows image tint, color, brightness, and contrast to be controlled.

Twain standard, any Twain-compatible piece of software should be able to acquire images directly through Snappy. The manual's appendix includes tips on getting the best results when scanning

There is a low-battery warning, and the system has a capable power conservation mode.

Since Snappy supports the

able to acquire images directly through Snappy. The manual's appendix includes tips on getting the best results when scanning

photos, slides, and negatives. The Snappy package also includes Gryphon Morph and a special edition of the Fauve Matisse paint and image-retouching program.

Snappy is accessible and fun to use. It's a complete starter kit for the image-manipulation hobbyist, yet the high quality of its images will satisfy graphics professionals.

Snappy Video Snapshot. Estimated street price: \$199.95. Requires: 4MB RAM, 4MB hard disk space, Microsoft Windows 3.1 or later, parallel port. Play Inc., Rancho Cordova, CA; 800-306-7529, 916-851-0800; fax, 916-851-0801.

Circle 421 on reader service card

DOCUMENT MANAGEMENT

Concordance: Mining for Informational Gold

By David Haskin

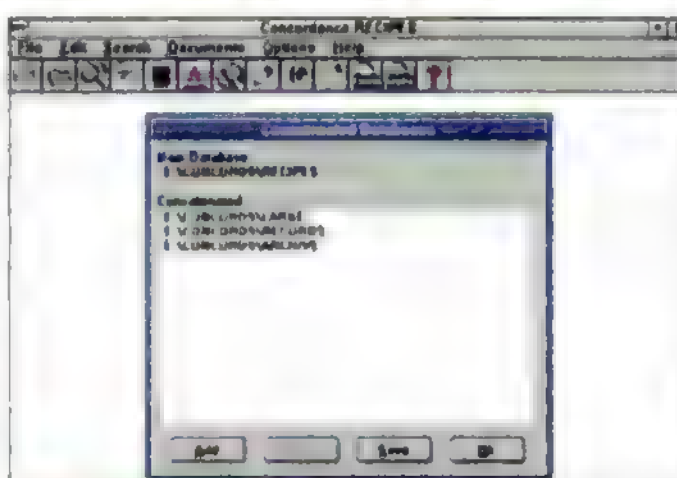
Information can be like gold: You have to sift through a lot of ore before you find a valuable nugget. Concordance 5.4 for Windows (\$995 for a single user) is an industrial-strength text-retrieval program. It isn't always easy to use, but it provides the power needed to glean informational nuggets out of mountains of textual data.

Rather than indexing files created by other applications, which is how many text-retrieval products work, Concordance lets you create text databases by typing information into fields or by importing files. Some shortcomings are that Concordance can only import ASCII files, and you can't initiate scanning sessions from within the program.

Concordance databases can include numeric fields, date fields, and fixed-length text fields. It also supports paragraph fields that can hold up to 64K of free-form text. Besides setting the field type when creating a database, you set other field attributes, such as whether the use of a pick list is mandatory for selecting data.

Concordance resembles fixed-

field databases in other ways, like how it speeds up searches by indexing. We found indexing speed acceptable but not blazing. On a 90-MHz Pentium system with 16MB of RAM, it took 11 minutes to index 2MB of imported text documents. You must reindex after adding or deleting information, a process that took about 5 minutes after changes were made to our test database. As it indexes, Concordance compresses text fields and index files to



LOOK EVERYWHERE: Concordance lets you join as many as 15 databases for a single search.

save disk space. On our test database, the compressed files required 2.65MB.

After indexing, Concordance completed text searches almost instantaneously on the Pentium test machine we used. You can search within any field using Boolean operators—like AND, OR, and NOT—and search within ranges in numeric and date fields. Con-

cordance supports searches for words within a specified proximity of other words and wildcard and sound-alike searches. The program is a step forward, able to search through as many as 15 databases in a single search.

After finding information, Concordance can sort on specific fields and tag records for later use. Concordance's report generator is simplistic, and its programming language can automate some tasks. The programming language will help developers shield end users from Concordance's sometimes unfriendly interface. Missing are niceties such as dialog boxes that walk inexperienced users through the creation of complex searches. While the program is not difficult, you still must master Concordance's searching syntax to perform searches.

Concordance, which is also available in both DOS and OS/2 versions, is an excellent choice if brute power for managing text is more important than ease of use. **Concordance 5.4 for Windows Professional Edition.** List price: Single user, \$995; 10 users, \$4,000. Requires: 8MB RAM, 2MB hard disk space, Microsoft Windows 3.1 or later. Dataflight Software Inc., Los Angeles, CA; 800-421-8398, 310-471-3414; fax, 310-471-5294.

Circle 420 on reader service card

DATABASE FRONT ENDS

Speak with and Listen to Your Data with voysAccess

By Jay Munro

Nothing is more a sign of the times than the proliferation of interactive telephone systems that invariably prompt you with this phrase: "If you have a Touch-tone phone, press 1 now." Voysys's \$995 voysAccess for FoxPro for Windows takes this concept a step further by tapping

routine, but we found that an experienced programmer can catch errors in most function calls.

To help programmers get started, voysAccess comes with tutorials that create two IVR applications. The first application answers a call, asks for a name and some digits, plays them back to the caller, says "bye," and hangs up. Although it is deceptively simple, it gives prospective voysAccess programmers basic information to work with and tells them how to program the beginning and end of any voysAccess program.

The second application is more complex and shows the potential of this type of system. It involves a caller interacting with a live database that reads an account balance. While still rudimentary, this application goes a long way toward

letting him accept or refuse each time slot with Touch-tone responses. And if the caller refuses a time slot, the database is updated.

ANTICIPATING QUESTIONS

Creating the code for IVR programs is only part of the battle; planning scripts and recording voice prompts complete the war. voysAccess includes a manual to help with the script-writing process ("Building Successful Interactive Voice Response Applications"). Because the system is based on recorded passages rather than a text-to-speech engine, developing an IVR application requires anticipating the caller's needs and recording the phrases required to support them.

No voice project would work without voice prompts to ask callers for input, and voysAccess comes with over 140 prerecorded voice prompts; from spoken letters, numbers, and simple words like "January" and "Dollars" to

in Version 1.1. The typical complex application requires the recording of special phrases and words.

While testing we found two ways to add custom voysAccess prompts: by recording the needed material on the phone or by using an existing PC-based sound board and the included voysSmith utility.

voysSmith contains not just the bare-bones recording and editing that a developer needs for voice prompts, but the capability to add special effects such as flanging, echo, stretching, and compressing voice (with both tempo and pitch control). voysSmith is also capable of customization of output through fast Fourier transform filtering and envelope control. And in case that's not enough, you can write music on a staff, view the waveform, view frequency distribution, and set the DC bias of your output.

As a first version, Voysys has done a good job of pulling together what is needed for producing rich IVR applications, though there are a few rough edges. Minor quibbles concern the product's less-than-polished manual and some workarounds needed to avoid minor documented problems. The biggest complaint is that the usefulness of voysAccess is limited because it works only with FoxPro databases. The company is working on increasing its scope of supported development languages over the next year.

With a simple but complete library interface, high-quality voice card and software, and excellent utilities, voysAccess answers the call for phone-in database software. If Voysys makes good on the promise of versions for other databases, voysAccess will likely evolve into a serious contender for the IVR development market.

voysAccess for FoxPro for Windows. List price: \$995. Requires: 8MB RAM (16MB recommended), 10MB hard disk space, Microsoft Windows 3.1 or later. Voysys Corp., Fremont, CA; 800-998-6979, 510-252-1100; fax, 510-252-1101.

Circle 407 on reader service card



VOICE CONFIRMATION: voysAccess lets the caller accept or reject any information.

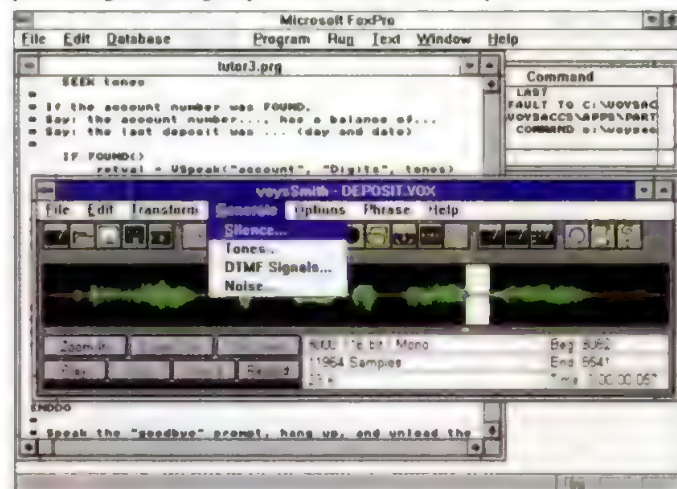
into a company's database to provide information over the phone.

The possibilities for this type of caller-database interaction are nearly limitless, including call-in dissemination of price, inventory, or scheduling information. In spite of some minor growing pains and support for only one database, voysAccess is the right number.

TWO PHONES, NO WAITING

voysAccess is a TAPI-compliant system that mates a two-telephone-line Dialogic voice board with software libraries and tools that make it easy to add interactive voice response (IVR) to your company's FoxPro for Windows database applications. voysAccess interacts with callers through eight discrete functions: answer phone, speak information, receive Touch-tone information, record messages, dial number, wait for a ring, check for hang-up, and hang up.

All voysAccess functions have return codes that the programmer can act on like success, hang-up, and time-out, or error messages like busy, no answer, or more serious board or server errors. Missing is a diagnostic



SOUND BENDER: voysSmith is a full-featured PC recording studio that can analyze and alter sounds used in messages.

filling in the rest of the basics.

voysAccess is two-way in that the system can not only read data to the caller but also accept some input. In another application, when a user calls in and correctly enters his employee number, the system reads a schedule of work for the upcoming week,

full phrases like "Please speak your four-digit account number." While the phrases are tailored for setting up a voysAccess application on interactive work scheduling, the provided audio files are just the start. Version 1.0 contains documentation for an extra 160 phrases that will be included

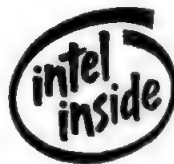
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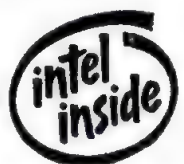
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PCS

Multiprocessing PCs: One Plus One Does Not Always Equal Two

By Nick Stam and Brian Nadel

The advent of dual-processing desktop Pentium PCs holds the promise of a two-for-one deal: Add a second CPU to your system and double your system's performance. Treat this as a claim that's too good to be true, but one that has a grain of truth to it.

The fact is that given the infrastructure of applications and operating systems, multiprocessing can provide an affordable performance boost and may very well be a viable upgrade route. The three dual-Pentium PCs we looked at (Dell's OptiPlex DGX 5100, Hewlett-Packard's Vectra XU 5/100C, and Micron's PowerServer SMP) fall short of the mark of doubling a PC's power. Yet each sells for close to twice the price of comparable single-CPU systems.

Multiprocessing in enterprise-wide servers is well established, but squeezing two processors into a desktop PC is still in its infancy ("One Size Does Not Fit All," May 31, 1994). It is not surprising that the three dual-Pentium systems we looked at had several Intel-inspired design similarities: Intel's MP Spec 1.1 is the architectural basis for the systems (see sidebar), and each system relied on the Intel-made Neptune logic chip set. In addition, these systems came with 512K of external cache, a PCI bus, and the Windows NT 3.5 operating system.

SAME, BUT DIFFERENT

There were subtle differences in equipment that led to variations in performance and focus. The \$7,900 Dell OptiPlex DGX 5100 came equipped with a 1GB SCSI hard disk, a PCI-based ATI Mach-64 video adapter, a 17-inch monitor, and a triple-speed CD-ROM drive. The \$7,545 HP Vectra XU 5/100 included a 1GB SCSI hard disk, a Matrox Impression Plus graphics adapter with a 17-inch monitor, and a quad-speed CD-ROM, and offers the convenience of built-in Ethernet

using 90-MHz CPUs instead of the dual-100-MHz setup the other two have. The PowerServer came with extra equipment: an additional 32MB of RAM and a tower case.

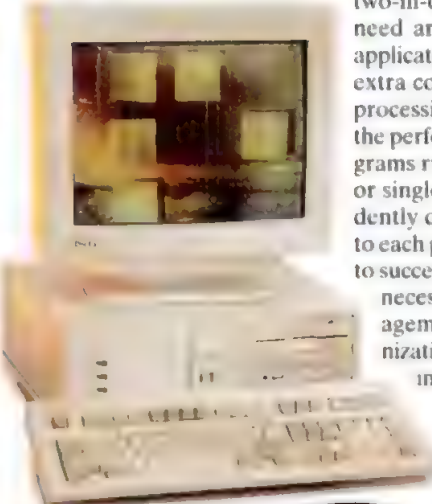
To effectively harness this two-in-one CPU system, you need an operating system and applications capable of using this extra computing engine. Multiprocessing systems can improve the performance of multiple programs running at the same time or single programs by independently doling out operations to each processor. The key to success is to reduce the necessary thread management and synchronization overhead to a minimum.

Each system used the workstation version of Windows NT 3.5, which automatically recognizes the number of processors installed and configures the operating system's kernel appropriately. Moving between single- and dual-processing is, however, not as easy as inserting or removing the second CPU. We found that we had to reinstall the operating system before the sys-

tems would work after upgrading to a dual-CPU configuration.

HOW WE TESTED

Because multiprocessing is just starting to gain favor on the desktop, there is a dearth of reliable benchmark tests and applications that can utilize the second CPU. Our traditional battery of desktop benchmark tests is no help for dual-processor systems. The closest thing to a mainstream shipping product was Micrograph's beta version (January 28, 1995) of Picture Publisher 4.0 for Windows



FAST, FAST, FAST: Dell's OptiPlex won the shootout among dual-Pentium PCs



NETWORKING INSIDE: The Vectra XU 5/100C includes a built-in Ethernet control chip



BENCHMARK TESTS

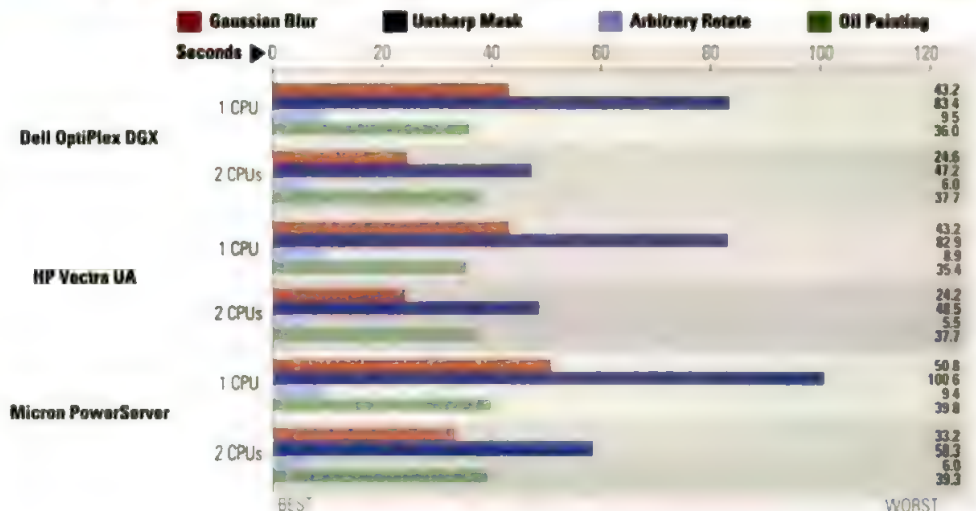
Dual-Pentium PCs



How much does having a second processor add to performance? Our testing of three dual-Pentium PCs showed that a second Pentium chip boosted performance significantly on multithreaded tasks. On the one application that was not multithreaded (Oil Painting), two out of

the three machines actually showed a slight slowdown.

We tested each PC with 32MB of RAM, 512K of external cache, a 1GB hard disk or greater, and Microsoft Windows NT 3.5. We timed how long each took to complete four tasks in Picture Publisher 4.0 for Windows.



First Looks

NT. Micrografx says the product will work on both Windows NT

and Windows 95, and will be released when Windows 95 ships. We found Picture Publisher to be a stable platform to evaluate the processor and memory differences among these systems and the potential of dual-processing systems.

We started testing these systems by loading a 7MB graphics image file entirely into system memory. This technique eliminated any disk access during testing, and effectively isolated the system memory and pair of processors from the rest of the system to show how much extra horsepower the second processor provided. Across the three systems, NT 3.5's virtual memory and tasking parameters were set identically.

The tests we ran consisted of timing how long it took to complete three of Picture Publisher's effects that support multithreading: Unsharp Mask (which sharpens a photographic image), Gaussian Blur (which distorts an image), and Rotate Arbitrary (which turns an image by a chosen amount). In addition, we timed the Oil Painting effect (which imparts an artistic look by applying brush strokes), but this application is not multithreaded. Picture Publisher's performance for this feature will gauge how much overhead dual-processing adds to single-threaded tasks.

EXTRA BAGGAGE OR EXTRA POWER

The three multithreaded tests showed a 60 to 75 percent increase in performance between single- and dual-processing modes—not quite double, but still impressive. On the other hand, there was a slight decrease in performance with the single-threaded Oil Paint-

EXTRA RAM: Micron's PowerServer SMP

comes with an extra 32MB of memory, compared with the other dual-Pentium



ing test, showing that the added processor management overhead amounted to extra baggage.

When the differing equipment levels are taken into account, the two 100-MHz systems offered nearly equivalent value; the Dell OptiPlex took a slight lead in performance. The Micron—which

used a pair of 90-MHz chips—was predictably off

the pace, but still far faster than any single CPU system. In a networked environment, the HP's built-in Ethernet is a bonus; the Micron's added 32MB of system memory will prove helpful manipulating large files; and the Dell's slight performance lead is for those who crave the absolute best performing PC on the market.

These systems stop short of doubling computing horsepower, but offer a significant power boost. The problem is that the lack of mainstream applications restricts this technology to the realm of high-end graphics professionals to whom saving a few minutes here and there adds to the bottom line. For the rest of us, adding a second CPU may prove to be a very effective upgrade path, but only when more applications can take advantage

of the extra power.

Dell OptiPlex DGX 5100. Estimated

selling price: With dual Pentium/100 CPUs, 32MB RAM, 512K external cache, 1GB hard disk, CD-ROM, 17-inch monitor, \$7,900. Dell Computer Corp., Austin, TX; 800-613-3335, 512-338-4400; fax, 800-727-8320.

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Vectra XU 5/100C. List price: With dual Pentium/100 CPUs, 32MB RAM, 512K external cache, 1GB hard disk, CD-ROM, 17-inch monitor, \$7,545. Hewlett-Packard Co., Palo Alto, CA; 800-322-4722, 415-857-1501; fax, 800-333-1917.

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PowerServer SMP. List price: With dual Pentium/90 CPUs, 64MB RAM, 512K external cache, 2GB hard disk, CD-ROM, 17-inch monitor, \$7,578. Micron Computer Inc., Nampa, ID; 800-347-3490, 208-463-3434; fax, 208-463-3424.

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The Architecture Behind Dual Processing

The designs of these multiprocessor Pentium machines sacrifice bleeding-edge performance in favor of simple implementation and low cost. Rather than providing each CPU with its own dedicated bank of external cache,

working from the same set of data.

You can't just use any old Pentium processor, though: you'll need a special version called the P54CM. The P54C is Intel's designation for the standard 90- and 100-MHz, 3.3-volt Pentium. The P54CM is the add-on multiprocessor-capable chip. Together, they form a dual-CPU system.

The P54CM is virtually identical to the standard Pentium except that one pin is configured to inform the system that the chip is a secondary processor and shouldn't be enabled until the operating system has been started with the primary CPU.

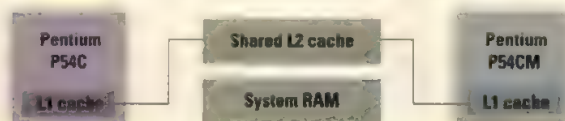
Building a DP-capable Pentium system requires little more than incorporating Intel's MP Spec 1.1, a socket for the second CPU, an SMP-ready operating

system, and a core-logic chip set to support it. Intel's Neptune chip set, currently used in most 90- and 100-MHz Pentium systems, supports dual processors. The newer and slightly higher performing Triton chip set does not allow dual processing.

Triton's lack of support for DP may indicate that Intel plans to refocus its multiprocessor plans around the P6 CPU due this summer. The P6 has an advanced bus that allows high-performance four-way multiprocessing without requiring any additional support logic on the motherboard. Since each P6 processor is packaged with 256K of L2 cache, such designs would necessarily use split rather than shared caches. —John Clyman

The Shared Approach to Memory

Shared-cache designs maintain cache coherency—ensuring that the two CPUs' data doesn't get out of sync—by using the Pentium's built-in MESI protocol. This standard flags entries in the cache to indicate which processor owns what, and where current data resides



these systems share a common cache (see diagram).

Traditional split-cache designs in two-way symmetric multiprocessing systems are more effective from a performance standpoint, because they allow each CPU to cache a larger amount of data and code and provide higher bandwidth. But, by sharing external cache, the design of the dual-CPU systems we reviewed is greatly simplified.

The biggest potential problem is that cache memory could get out of sync, and the two CPUs will be working with different data. When one CPU finishes working with a piece of data, the shared cache is updated using the MESI (Modified, Exclusive, Shared, Invalid) protocol. This ensures that both processors are always



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MULTIFUNCTION DEVICES

Xerox 3004: Impressive Integration, But Does It All Add Up?

By Alfred Poor

The "hydra" wars are heating up with the release of the Xerox Desktop Document Systems 3004. Estimated to sell for about \$1,200, this multifunction device can fax, copy, print, and scan. It promises to be the Swiss Army knife of desktop PC peripherals.

If you want to receive a fax on plain paper, make a quick photocopy of a document, scan in a logo or photograph to augment your report, send a fax to a client from your word processing screen, or even do something as commonplace as print a letter or report, you would normally need several distinct pieces of hardware—printer, scanner, copier, and fax modem—connected to your PC. But with serial and parallel-port connections to your computer, the Xerox 3004 can perform all those tasks by itself. Whether it performs them more economically than individual components would is another story.

PHONE-CUM-PRINTER

The 3004 is the middle sibling of Xerox's 300x family of multifunction devices. At the low end, the 3002 gets by with a 9,600-bit-per-second modem compared with the 3004's 14,400-bps modem, while the high-end 3006 has more memory and advanced work-group features.

Appearing much like a plain-paper fax machine, the 3004's dimensions (18 by 16 by 6 inches) belie the fact that it is a four-in-one device. Open the input tray for the scanner, and you are confronted with a typical telephone

dialing keypad, along with controls for resolution and contrast and an array of programmable speed-dialing buttons. There is also a separate control panel that looks like one from a typical printer: The LCD window has notations for on-line, form feed, and a menu-driven configuration system. The printer portion is HP DeskJet 500-compatible, so all you need to do is hook a parallel cable up to your PC and you're in business.

Load the software, however, and the 3004 really starts to show its worth. The Windows printer driver is fairly typical, but there is also a Twain-compatible scanner driver that makes it possible to scan directly into any Windows application that supports the Twain standard. Resolution is up to 300 dots per inch, and the 3004 includes a copy of Xerox's TextBridge OCR software, which does an excellent job of recognizing characters on paper. In our testing, TextBridge generally maintained typeface, point size, and formatting of the text that it imports with the variety of source material used in our tests.

SLOW BUT SURE

The software and scanner are not as accurate as some dedicated scanners, and the image transfer

JACK OF ALL TRADES: Xerox's 3004 is an all-in-one printer, scanner, copier, and fax machine.

rate is much slower because the data flows across a serial cable rather than a SCSI connection. But for one or two pages at a time, it is certainly faster than—and probably just as accurate as—typing for most people, and it is a better idea than faxing yourself a page to capture an image. The scanner recognizes up to 64 shades of gray, but graphics are dithered and imported into your applications as 1-bit black-and-white images.

Xerox's 3004 also comes with a copy of Delrina's WinFax LITE. Since the 3004 is a Class 2-compatible fax modem, you can use it with just about any PC-based fax software you wish, should you grow out of WinFax LITE's features. The 14.4 kilobit-per-second modem for fax transmissions helps keep transmission time short.

There's a Windows application that gives you on-screen access to all the configuration features of the Xerox 3004, which is far easier to use than the endless series of menus displayed in the unit's small LCD message win-

Xerox 3004 is excellent. The ink jet print head has 128 nozzles and produces 300-dpi output. There was some faint evidence of horizontal streaking on some graphics images, but none of the pronounced banding that can be the downfall of some ink jet printers. Characters are well formed, sharp, and clear. In fact, the output rivals some low-end laser printers. The printer is rated at 3 pages per minute, and on our text speed tests, it managed to produce 2.5-ppm results.

HYDRA MATH

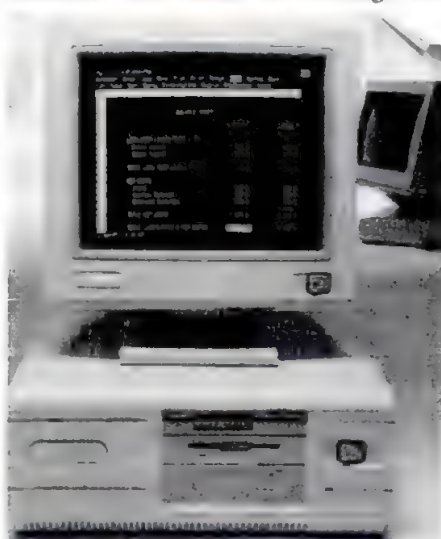
Each of the individual functions and the level of integrations of the Xerox 3004 are impressive. At an estimated street price of around \$1,200, the question remains whether you would be better off buying a fax modem, laser, or ink jet printer, and scanner. The bottom line is that you can put together a combination of components that will perform as well or better for the same amount of money or less.

But therein lies the appeal of the Xerox 3004: You don't need to build your own integrated set of components from scratch, because they are all available to you right out of the box. No muss, no fuss; and if anything goes wrong, you need only turn to a single source for support. Xerox provides a one-year exchange warranty and toll-free technical support, and it has a presence on CompuServe for on-line support.

If you already have a significant investment in any one of the major functional components—printer, scanner, copier, fax—you probably don't want to duplicate them by buying a multifunction device like the Xerox 3004. But if you're setting up a small office where space is at a premium and you want one peripheral to do the job of four, the Xerox 3004 is an excellent place to start.

Xerox 3004. Estimated street price: \$1,200. Requires: 4MB RAM (8MB recommended), 5MB hard disk space, parallel port, serial port, Microsoft Windows 3.1 or later. Xerox Desktop Document Systems Division, Palo Alto, CA; 800-275-9376, 415-813-6800.

Circle 405 on reader service card



FUZZY AROUND THE EDGES: The output from the 3004 has slight streaking.

dow. A real time-saver is the feature that allows you to program the speed-dial buttons from your PC's keyboard.

All these features aren't worth much if the printer output is hard to read. That's not a problem here; the print quality of the

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INTERNET ACCESS

Instant Internet Connects Your Network Safely

By Craig Ellison

Your organization has a NetWare network and now you want it to reach out to the Internet as well. The problem is that the Internet requires that data packets be in a format called the Internet Protocol—or IP for short—not Netware's similar-sounding but vastly different IPX protocol. Rather than using IP software from companies like Spry or Novell and spending days configuring each network workstation, Performance Technology's \$3,495 Instant Internet provides a reliable and safe way to connect your LAN to the Internet.

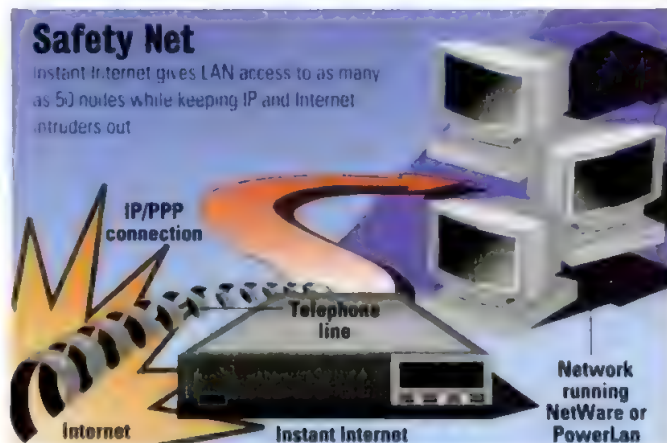
Performance Technology's Instant Internet is a plug-and-play device the size of a small pizza box that can handle 50 simultaneous Internet sessions for anyone with a networked PC on a NetWare or PowerLan network. The actual connection to the Internet is via its built-in V.34 modem or through your Inter-

net-capable network.

Instant Internet is installed by connecting it to the LAN and a phone line. At each PC you load a special Winsock driver and Internet utilities that include WinWeb,

several other browsers we tried.

While the program includes a list of over 80 Internet-access providers along with their phone numbers and IP addresses, you have to make your own billing



a World-Wide Web browser with a file-transfer protocol (FTP) client, a newsreader, and an e-mail client. During testing, the package worked well with the bundled software as well as with

arrangements with the Internet provider you use.

The throughput of Instant Internet depends solely on the communications line you use. The internal V.34 modem can efficiently

provide on-demand dial-up access to carry several simultaneous file transfers or dozens of World-Wide Web sessions. But we found that if several network clients spend time pulling down graphics files, you'll probably need an ISDN or a leased-line connection to avoid bottlenecks.

Competing Novix software from Firefox Systems (\$1,425 for five users; you supply the hardware) takes a different approach to networked Internet sessions. It runs as an NLM on a NetWare server, which can leave your network vulnerable to slow-downs.

While Instant Internet gives administrators adequate control over its actions, it stops short of generating usage reports for billing and time management. Instant Internet's simplicity and security make it a sure choice for Internet access in NetWare LANs. **Instant Internet.** List price: \$3,495. Requires: NetWare or PowerLan network, PCs with Microsoft Windows 3.1 or later. Performance Technology Inc., San Antonio, TX; 800-784-4638, 210-979-2000; fax, 210-979-2002; info@instant.net.

Circle 406 on reader service card

MATHEMATICS SOFTWARE

Theorist 2: Easy to Learn, Easy to Outgrow

By Barry Simon

Waterloo Maple Software's \$299 Theorist 2, long a staple of the Macintosh mathematical software market, makes its debut on Windows. The program stands out for its easy-to-learn user interface, but Theorist's underpowered symbolic-mathematics engine will make it attractive only to a limited audience.

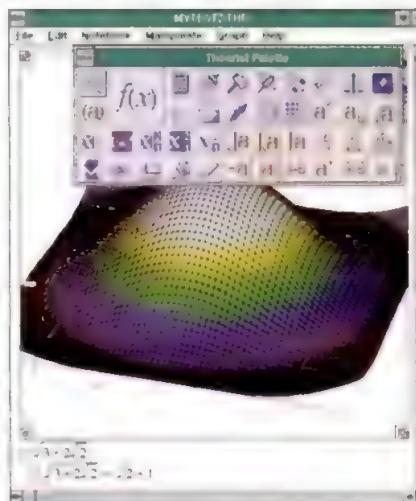
Theorist, like Scientific Workplace, MathCAD, and Maple's Expressionist mathematical symbol editor, uses natural symbolic notation to enter formulas by selecting symbols from a palette of choices. The key is that you don't need to remember arcane syntax. To set up an integration formula, for example, you just enter an integral symbol and fill in the place holders.

In addition, Theorist adds an outline structure that is easier to use than the comparable features in Macysma, Maple, and Mathe-

matica. And because its primary purpose isn't to produce structured documents for printing reports or scientific papers, Theorist will likely be easier to pick up and learn than Scientific Workplace or MathCAD.

The major drawback is that Theorist's mathematical engine is vastly inferior to the one in Scientific Workplace and MathCAD, which ironically uses an engine licensed from Maple. The Windows program's underlying engine can perform algebra and symbolic calculus, but does not go beyond the basics. The engine can't do arbitrary-precision real arithmetic, and not all operations will maintain exact rationals. Rather,

precision is limited to 15 decimal places. And some operations in Theorist—like multiple surds—are done exactly, while others—like in-



PICK AND SEE: Theorist's 3-D graphics let you plot complex formulas by choosing styles from the palette.

version of rational matrices—shift to real numbers. You can do matrix algebra and compute determinants, but there is no provision for performing eigenvalue routines.

Theorist includes basic two- and three-dimensional graphs, an ordinary differential equation solver, and some advanced functions like the Bessel and gamma functions, but no programming language. The natural notation and outlining help make the basic interface understandable and accessible, but Theorist lacks a button bar or other method of speeding menu choices.

Maple plans a future version of Theorist that will use its superior mathematical engine, but for now, those with serious mathematical needs will have to look elsewhere. **Theorist 2.** List price: \$299; upgrade, \$110. Requires: 4MB RAM, 2MB hard disk space, Microsoft Windows 3.1 or later or Windows NT. Waterloo Maple Software, Waterloo, Ontario, Canada. 800-267-6583, 519-747-2373; fax, 519-747-5284.

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New & Improved

NEWS OF ANNOUNCED PRODUCTS AND UPGRADES

By Asa Somers

Your PC Makes the Call

PhoneKits is a Windows-based telephony package from **AlgoRhythms** that puts all the functionality of your business phone on-screen. The four PhoneKits modules—PC Phone, Call Log, Answering Ma-



HAVE IT YOUR WAY: PhoneKits lets you easily customize your on-screen phone.

chine, and Address Book—let you call anyone in your phone database by typing the first few letters of their last name. More impressively, you can highlight a phone number in any Windows application and click on the PhoneKits icon, and the program will immediately dial the number. Configuring your on-screen phone is as easy as dragging and dropping a dial pad and other controls onto the phone screen. PhoneKits has fax, voice-mail, call-tracking, and caller-ID features, as well. **PhoneKits.** List price: \$79.95. **AlgoRhythms Inc.,** Dallas, TX; 800-799-5487, 214-490-5487.

Circle 410 on reader service card

Sidekick's on the Move

Starfish Software, founded in 1994 by former Borland CEO Philippe Kahn, is shipping Version 2.0 of Sidekick, the popular personal organizer formerly owned by Borland. This new version lets you open multiple cardfiles and provides over 70 templates for printing labels, envelopes, and paper-based organizer pages. You can schedule more than one activity for the same time period, thanks to an overlapping-appointment capability, and Sidekick 2.0 lets you create as many notes fields as you desire, import text files, and update reports dynamically. Best of all, Version 2.0 requires only 3MB of hard disk space.

Sidekick, Version 2.0. List price: \$49.95. **Starfish Software, Scotts Valley, CA;** 800-370-8963; fax, 716-873-0906.

Circle 411 on reader service card

Photography by Thom O'Connor



ProLinea: Standalone Value On the Desktop

Compaq's value-line ProLinea, with the same basic hardware configuration and performance levels as the networkable Deskpro series (for more information on the Deskpro, see page 37 of First Looks in this issue), has undergone a complete face-lift. The new desktop systems come in both 486- and Pentium-based models and offer a host of features aimed at the SOHO market.

For around \$2,000, you can purchase a new ProLinea 575, which comes with a 75-MHz Pentium CPU, 8MB of RAM, a 420MB hard disk, four expansion slots, and four bays. You can easily upgrade your system board—by removing three thumb screws—to 90- or 100-MHz Pentium power. Hard disk options range from 270MB to 2.1GB, and you can expand the RAM in the 486-based models to 136MB and in the Pentium-based models to 192MB via standard SIMMs.

The ProLineas are Windows 95- and Plug and Play-compliant, and feature Compaq's TriFlex/PCI architecture. They come in desktop or minitower configurations, and additional options include quad-speed CD-ROM drives, a business audio upgrade, the QVision 2000+ graphics accelerators—which come with 2MB to 4MB of VRAM—and a variety of tape drives, modems, and network adapters.

Compaq ProLinea. Estimated street price: With Pentium/75 processor, 8MB RAM, and 20MB hard disk, \$1,999. **Compaq Computer Corp., Houston, TX;** 800-888-5858.

Circle 409 on reader service card

Graphics Prices Drop Through the Floor

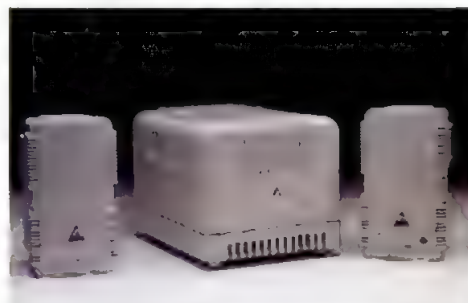
Micrografx has recently announced the Designer Power Pack, which includes Micrografx Designer 4.1 Technical Edition, Picture Publisher 5.0 for Windows, and HSC Software Corp.'s Kai's Power Tools. The Power Pack is available to registered users of any of these packages or of competitive graphics software for \$199.95. In addition to these three high-end graphics products, Micrografx also includes 15,000 pieces of clip art, 300 stock photos, and 250 fonts. The Power Pack comes on a single CD-ROM and is available on the street to first-time graphics users for \$349.95. You can purchase any single component of the Power Pack as an upgrade or competitive upgrade for \$99.95.

Designer Power Pack. List price: As an upgrade or competitive upgrade, \$199.95. **Micrografx Inc., Richardson, TX;** 800-733-3729; fax, 214-994-6227.

Circle 413 on reader service card

PC Sound Can Cook

Its name makes it sound like something you would bake fish in, but the M105 Bass Toaster, from **Atlantic Technology International**, is a floor-mounted, self-powered subwoofer that is designed to give PC-based sound applications oomph. The Bass Toaster has a built-in 45-watt power amplifier and 6.5-inch woofer; it lacks a bulky adapter as the power supply remains inside the casing. You can adjust upper bass response with the crossover selector switch that is mounted to the casing. Atlantic also offers the M110 stereo monitors for use with the Bass Toaster. The right-hand unit contains a 10-watt stereo amplifier and houses the external volume,



FISH FRY: The Bass Toaster and the M110 stereo speakers serve up hi-fi sound.

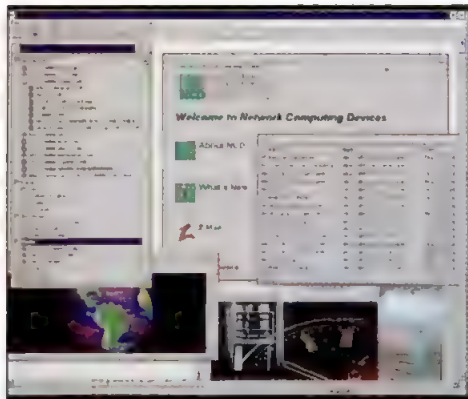
New & Improved

treble, and power controls, as well as dual-input jacks for accommodating a second audio source. **M105 Bass Toaster.** List price: \$229. **M110 stereo speakers.** List price: \$119 per pair. Atlantic Technology International, Norwood, MA; 617-762-6300; fax, 617-762-6868.

Circle 415 on reader service card

Mariner: The Single-Interface Internet Tool

Network Computing Devices has announced Mariner, a new Internet navigation tool that will provide a unified interface for accessing all services and protocols, including the Web, e-mail, FTP, IRC, Gopher, and Telnet. Scheduled to ship in June, Mariner will support off-line operation, checking dates of selected documents and automatically updating them once you reconnect. Dynamic rendering capabilities will allow Mariner to navigate to hyperlinked documents while the images are being retrieved, which increases the program's response. With Mariner's multitasking architecture you'll be able to ex-



TAKE IT OFF-LINE: Mariner automatically updates selected files when you reconnect.

plore multiple Web sites simultaneously, or send e-mail and read Net News at the same time.

Mariner. List price: Until September 30, \$99; thereafter, \$125. Network Computing Devices, Mountain View, CA; 800-416-1956, 415-694-0650; fax, 415-961-7711.

Circle 416 on reader service card

Velocity 64V Pushes Pixels with EDO

For mainstream and high-level graphics applications, the new Velocity 64V graphics accelerator from **STB Systems** uses the S3 Vision968 engine and up to 4MB of EDO VRAM to paint images. The model comes in either PCI or VESA local-bus versions and, when configured with the maximum amount of VRAM, supports a noninter-

SOFTWARE BRIEFS

Intek Technologies has begun shipping Clarity, a new and affordable database-development tool. Providing integrated visual-modeling capabilities, Clarity's Rapid Modeling Diagrammer lets you reuse or modify models before it automatically generates a prototype. The Object Gallery lets you store and retrieve all objects, which are accessible via full OLE automation. The \$149 Clarity supports PowerBuilder and can generate to ODBC, Sybase, and Oracle databases. 800-654-3249

Sky watchers will want to focus their telescopes on EclipseComplete from **Zephyr Services**. This \$149.95 DOS-based software package lets the amateur astronomer chart the path of solar and lunar eclipses. You can generate detailed maps, see on-screen animations of the eclipse, and display detailed information about the local circumstances of an eclipse. You can even explore eclipses described in ancient Greek, Babylonian, and Chinese writings. 800-533-6666.

DPC Computers is shipping ZIPsales Data Base, a DOS-based program that provides the specific sales- and use-tax structure for a given ZIP code. The database is fully searchable by ZIP code, city, county, or state, and you can export the information into any spreadsheet, database, or word processor. ZIPsales Data Base comes in single-state (\$199), five-state (\$499), ten-state (\$799), and all-state (\$999) packages and is updated monthly. 914-426-3790.

Multimedia MBA, Corporate Edition, jointly released by **Richard D. Irwin** and **SoftKey International**, is a CD-ROM that features the full text of nine business-related textbooks, as well as instructional videos, a number of charts and graphs, and tutorials on both fundamental and advanced business topics. The \$149.95 CD-ROM is fully searchable and includes its own personal organizer. 800-634-3966

A new information manager from **Phantech Software** called InfoRecall PRO lets you organize and retrieve information from diverse sources. Based on Phantech's mainstream InfoRecall product, the PRO version allows for searches across a specific index of files, all files currently open, or all files. The product includes a word counter, spell-checker, date stamping, ASCII import and export capabilities, and support for DDE. 800-203-1311.

laced resolution of 1,600-by-1,200 with 65,000 colors and a refresh rate of 80 Hz. The Velocity 64V delivers full-screen, full-motion video and handles Indeo 3.2- and Cinepak-compressed .AVI clips. The included Vision 2.0 software offers features such as multiple desktops, a zoom window, and dynamic resolution switching.

Velocity 64V. List price: with 2MB of VRAM, \$299; with 4MB, \$499. STB Systems Inc., Richardson, TX; 800-234-4334, 214-234-8750; fax, 214-234-1306.

Circle 414 on reader service card

The Wide-Screen Austin Vista: Now Taking Orders

IPC Technologies (formerly Austin Computer Systems) has announced the new Austin Vista Notebook, which offers two hot new features: an optional 11.3-inch, dual-scan color screen and built-in voice-command recognition. The Vistas come in a variety of configurations ranging in price from \$2,549 to \$4,878. You can specify either the 11.3-inch or the more expensive 10.4-inch active-matrix screen; 8MB, 12MB, 20MB, or 28MB of RAM; and a 340MB, 524MB, or 810MB hard disk, with a 1GB option to be available soon. In addition, every Vista incorporates Cylogic Voice User for Windows, which lets you control many of your notebook's



LISTEN CLOSELY: The Vista responds to 300 different commands.

functions via a set of 300 voice commands.

Austin Vista Notebook. List price: \$2,549 to \$4,878, depending on configuration. IPC Technologies Inc., Austin, TX; 800-752-1577, 512-339-3500; fax, 512-454-1357.

Circle 412 on reader service card

Designer Labels for Less

Billed as a "desktop-publishing package for labels," Smart 'n Sticky, from **Insight Software Solutions**, provides a number of design features you might not expect to find in an attractively priced labels product. You can rotate text in 90-, 180-, and 270-degree increments, while the program has Undo and Revert functions, support for

WinBook XP

Choose the pointing device that works best for you:



TECHNICAL SPECIFICATIONS

- SL-ENHANCED INTEL 486 DX4-75MHZ OR 486 DX4-100MHZ
- 5.9 LBS. DUAL-SCAN COLOR OR 6.1 LBS. OPTIONAL ACTIVE MATRIX COLOR
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- VGA DUAL-SCAN COLOR OR OPTIONAL ACTIVE MATRIX MONOCHROME UNITS ALSO AVAILABLE
- 10-CELL NiMH BATTERY & AC PACK
- SUSPEND/RESUME FEATURE
- TWO TYPE II OR ONE TYPE III PCMCIA SLOT
- INTEGRATED DUAL-BUTTON POINTING STICK, OPTIONAL DUAL-BUTTON 19MM TRACKBALL OR OPTIONAL DUAL-BUTTON TOUCHPAD
- PARALLEL, SERIAL AND PS/2 PORTS
- 1MB VIDEO MEMORY WITH EXTERNAL VGA PORT
- LCD FUNCTION INDICATOR PANEL
- 14.4 SEND/RECEIVE FAX/VOICE/DATA MODEM OPTIONAL
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- DOCKING STATION OPTIONAL

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DIO/DO 4085 Dual-scan color



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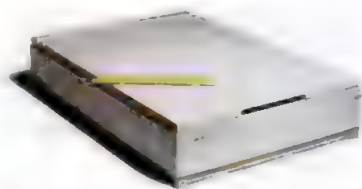
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CIRCLE 065 ON READER SERVICE CARD



The Canon Color Scanner. that's *really* just an



The Canon IX-4015 is the smallest flatbed color scanner there is. But even though it can fit in a small

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The OFOTO[®] 2.0 software does all the hard stuff--cropping, straightening and sharpening the image--while Caere's OmniPage[®] Direct OCR software scans your documents right into your word



Perfect for the corner office office in the corner.



processor, just as if you typed them yourself. (FYI, the Canon IX-4015 can double as a color copier.)*

You'll also be happy to know, the Canon IX-4015 comes with a two-year limited warranty, as well as a price tag that fits nicely

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For more information on the Canon IX-4015 scanner, just give us a call at 1-800-848-4123, Ext. 111. Remember, we're in your corner.

Canon

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.BMP and scalable .WMF files, and a feature to let you print the contents of the Windows Clipboard onto your labels. Smart 'n Sticky is also a full OLE client, so you can create objects in a number of third-party applications for use in your labels.

Smart 'n Sticky. List price: \$34. Insight Software Solutions, Bountiful, UT; 801-295-1890; fax, 801-299-1781.

Circle 429 on reader service card

Noteworthy Cuts Lines— Not Ties—to Your LAN

Mobile professionals wishing to access the network back at the office can do so at 14.4 Kbps over a cellular-phone network with the new Noteworthy Cellular-Ready modem from **Toshiba America Information Systems**. The Noteworthy also supports V.34 speeds over standard phone lines. The PC Card Type II modem ships with a connector for standard phone transmissions, but direct connect cables for specific cellular phones are sold separately. The Noteworthy modem also

features Celeritas Technologies' Throughput X-Cellerator, a cellular firmware technology that enhances data and fax transmissions.

Noteworthy Cellular-Ready modem. List price: \$399. Toshiba America Information Systems Inc., Irvine, CA; 800-959-4100.

Circle 417 on reader service card



LOOK, MA! Make the cable-less connection.

Quad-Speed CD-ROM Drives Going Cheap

For the home user who wants to upgrade to quad-speed CD-ROM technology without investing a fortune, **Reveal Computer Products** has begun shipping three CD-ROM bundles. Each one of the bundles includes a quad-speed drive offering a 250-ms search time and a 600-Kbps transfer time.

The \$199 CDQ100 package includes the New Grolier Multimedia Encyclopedia; the \$229 CDQ200 comes with a host of game CD-ROMs, including The 7th Guest and Return to Zork; and the \$229 CDQ300 comes with a mix of 13 titles.

Reveal CDQ100, 200, 300. Estimated street price: \$199, \$229, and \$229, respectively. Reveal Computer Products Inc., Woodland Hills, CA; 800-326-2222, 818-704-6300; fax, 818-883-1767.

Circle 418 on reader service card

AT&T Paradyne has begun shipping the new AT&T DataPort Express family of V.34 modems. Both the \$279 internal and \$299 external models are compatible with most lower transmission speeds and come with QuickLink II fax and communications software. 800-482-3333.

Samsung Electronics America has introduced its first subnotebook, the SensLite 200. It comes with either a low-voltage DX2/50 or DX4/75 CPU, a 7.8-inch active-matrix screen, 4MB of RAM (upgradable to 20MB), and a 260MB, 340MB, or 520MB hard disk. Pricing starts at \$1,999. 800-933-4110.

Technology Works is shipping the Thunderbolt64 family of entry-level graphics accelerators featuring the 64-bit Sierra Falcon chip. The 1MB version lists for \$129; the 2MB version costs \$179. Each supports ISA, VLB, and PCI buses. 800-688-7466.

So you need to reboot your computer at midnight and you don't feel like driving to the office to do it? The \$109.95 programmable VersaTimer power scheduler from **Server Technology** lets you specify up to 96 daily power-control events. You use the VersaTimer's included Windows-based software to program each event, and connect regular three-prong wall plugs—such as those on your computer and monitor—to the VersaTimer's three outputs. 800-835-1515.

Directed at the CAD/CAM and multimedia markets, the high-end Smile CA2011 20-inch monitor from **Smile International** supports a maximum resolution of 1,280-by-1,024 with a refresh rate of 72 Hz. The \$1,399 model features an Invar shadow mask, a host of on-board digital controls, and 9 factory preset and 27 user-programmable memory channels for saving screen settings. 714-546-0336.

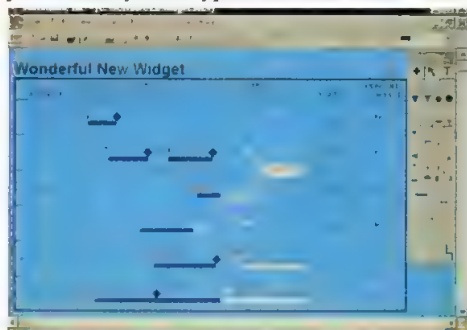
Xerox subsidiary **PixelCraft** is shipping the Pro Imager 7000 high-end flatbed scanner for \$9,995. The 24-bit scanner handles images of up to 11.7 by 17 inches in size with a maximum resolution of 2,400 dpi. It comes with Series II QuickScan image-acquisition software, but you'll need to buy a separate adapter to capture 24-bit data from transparencies. 800-933-0330; fax, 510-562-6451.

AND FINALLY...

Zenith Data Systems has reduced prices on its high-end Z-NoteFlex notebook computers by up to 13 percent. ... **Panasonic Personal Computer Co.** has cut prices on its V41 CD-ROM notebooks by up to \$300.

Manage Projects from a Whole New Angle

Kidasa Software's Milestones, Etc., now in Version 4.5, is a project-management tool designed to provide high-end features and a simple, intuitive interface. You can create Gantt charts and other schedules via drag-and-drop, and expand or collapse task and subtask outlines with a single mouse click. Kidasa has improved the interface between Milestones and Microsoft Project—allowing for dynamic on-screen mapping of project fields, symbol types, and task links—while



ON SCHEDULE: Create charts via drag-and-drop with Milestones' new intuitive interface.

the product's enhanced interface features balloon help and tab dialogs.

Milestones, Etc. Version 4.5. List price: Single-user version, \$189.95; five-user network version, \$700. Kidasa Software, Austin, TX; 512-328-0167; fax, 512-328-0247.

Circle 419 on reader service card

Mitsubishi Monitors the High-End Situation

Designed for high-end design applications such as CAD/CAM, the DiamondScan 20H 20-inch monitor from **Mitsubishi Electronics America** lists for \$1,750. It features a 0.28-mm dot pitch, supports a maximum noninterlaced resolution of 1,280-by-1,024 at a refresh rate of 75 Hz, uses the advanced-focus NX-DBF electron gun for uniform colors, and incorporates Mitsubishi's Digital Chassis design, which offers a number of basic and more esoteric monitor calibrations. These include moiré cancellation and rotation and purity adjustments. Diamond Control software comes with the monitor and provides computer-controlled adjustment of display parameters, while the DiamondMatch Color Calibrator Kit allows designers to achieve accurate representations of printer colors on-screen.

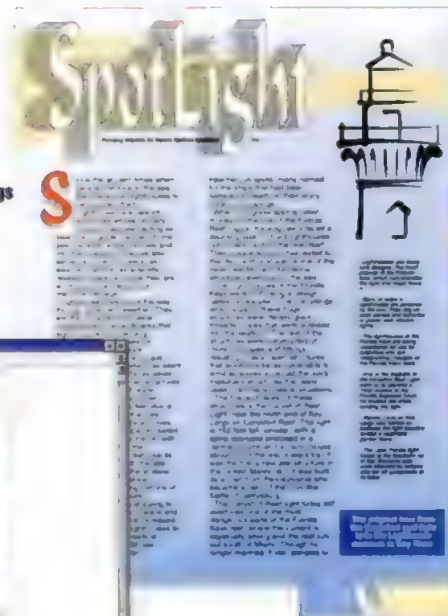
Mitsubishi DiamondScan 20H. List price: \$1,750. Mitsubishi Electronics America Inc., Cypress, CA; 800-843-2515.

Circle 430 on reader service card

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- PC Magazine

"... a truly versatile drawing and illustration package."

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Everything You Need to Create Great Looking Graphics. Fast.

THE EASY-TO-USE DRAWING PROGRAM FOR BUSINESS, DESIGN, TECHNICAL ILLUSTRATION AND MORE!

No matter what your graphics needs are, Canvas helps you do it faster — and easier! All the tools you need to take any idea from concept to printed page are conveniently located in a single, intuitive application.

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At almost half the price of its closest competitor, Canvas is an unbeatable value. And now we've made it even better by including in every box a CD-ROM jam-packed with more than 10,000 premium clip art images and over 2,000 professional TrueType text, display and novelty fonts — more than any other package at any price!

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- PC World

"... armed to the teeth with top-notch design tools."

- PC World

"... Canvas is an excellent buy."

- Computer Shopper

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CANVAS INCLUDES

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- 60-Day, Risk-Free Money-Back Guarantee

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- Simply show us proof of ownership of any Windows graphics program and chop nearly \$300 off Canvas' already low \$399 price! Visit your favorite reseller today or call

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which it was designed with diagnostics written by the system's original manufacturer.

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PC MAGAZINE CIRCLE 106 ON READER SERVICE CARD

Read Only

REVIEWS OF THE LATEST BOOKS FOR THE PC USER

Edited by Tin Albano

How to Make (or Spend) Money on the Info Net

BY EDWARD MENDELSON

Everyone in business dreams of getting rich on the Internet. If you read *Net Money: Your Guide to the Personal Finance Revolution on the Information Highway* by Kelli Maloni, Ben Greenman, and Kristin Miller, you probably won't learn how to get rich, but you'll discover hundreds of on-line sites where you can talk about getting rich, and you can learn where to look on the Internet if you want to get poor by buying things you don't need.

Net Money is the latest in a series of Net Books from Random House, each one describing more than 2,000 World-Wide Web sites, on-line conferences, BBS forums, and commercial and shareware programs. Earlier titles in the series include *Net Games* and *Net Chat*. *Net Money* focuses on on-line information about investments, taxes, careers, college scholarships and tuition, and shopping.

Each entry gets a description (averaging 50 words) and instructions for finding the item on the Internet, BBSs, or on-line services like CompuServe or America Online. The book is designed as an all-inclusive grab bag rather than a selective survey. If you want to buy veggie burgers on-line, you'll find the Web address here, but you'll also learn how to find the Federal Register on GEnie.

Many of the entries point you to discussion groups where you

can hear other people complain about their business experiences, but you probably won't learn much. The section on investment gives you no warning that you're likely to find scam artists offering worthless stocks on-line—just as they do over the phone, but with more impressive graphics.

The brief addresses at the end of the various entries are sometimes wrong and often puzzling. If you don't study the small print in the introduction, you'll have no idea what RelayNet and SmartNet are, let alone how to find them. Some software is listed under only one on-line service,

when you can also find it on many others. Don't rely on the sidebar on "IP Software" if you want to figure out how to get on the Net via Windows, because almost every Windows-related fact in the sidebar is wrong. Despite its superficial approach and minor errors, this book is unmatched in the breadth of information it offers on money and related issues on the Internet and on-line services. But don't expect to find much depth, and be prepared to take a lot of its wide-eyed enthusiasm with a substantial grain of salt.

Net Money: Your Guide to the Personal Finance Revolution on the Information Highway, A Michael Wolff Book, by Kelli Maloni, Ben Greenman, and Kristin Miller, \$19; Random House Electronic Publishing, 800-793-2665; ISBN: 0-679-75808-9. Circle 514 on reader service card



READ ONLY RECOMMENDS



So you got a guide to the Internet and found, much to your dismay, that many of the sites listed were not really there. Get used to it. Web pages, news groups, and mailing lists come and go. Next time get Ruffin Prevost's *Internet Insider*. A kind of *Weekly World News* or *National Enquirer* for the Net, the book lists the most bizarre places in cyberspace. And though many of the sites might be extinct by the time you get on-line, the book is nevertheless an entertaining read. *Internet Insider*, by Ruffin Prevost, \$14.95; Osborne McGraw-Hill, 800-227-0900; ISBN: 0-07-882084-7.

Exhausting Edutainment

BY CADE METZ

Seldom do you see the juxtaposition of an allusion to Francis Ford Coppola's *Apocalypse Now* with the ingenuous drawings of a four-year-old. Such contrasts litter the landscape, however, in *That's Edutainment!* by Eric Brown. The book's discussion of educational multimedia software and its related fields is geared toward the intelligent parent but keeps an unblinking eye on the child.

The first half of the book covers everything from the rise of edutainment to the fall of public schooling and the history of educational reform. The discussion supplies you with everything you need to know to make multimedia a part of your child's life at home and at school. Parts of the discussion are superfluous, but most of it is edifying and practical, like the breakdown of edutainment software by learning process and the advice on how to buy an ideal multimedia PC.

Reviews of the top 100 edutainment titles fill the book's second half. With over 150 products shipping every month, compiling

an organized and representative group of the best products on the market is daunting. But Brown has developed a collection of terse reviews that offer extremely visual descriptions and opinions from both children and professional educators. Each two-page review is accompanied by a two-sentence synopsis, a

range of appropriate ages, large screen shots with captions, and a detailed "report card" that evaluates according to a 15-category rubric.

For those who want more than words and staid

screen shots, *That's Edutainment!* also provides a "Try-Before-You-Buy" CD-ROM that offers demo versions and three-day trial versions of several software titles reviewed within the text.

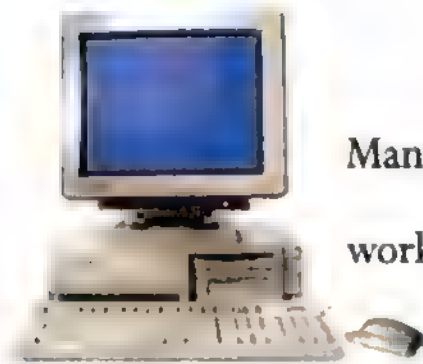
If you plan to use educational software as a part of your child's upbringing, then *That's Edutainment!* is your gospel.

That's Edutainment!, by Eric Brown, \$29.95; Osborne McGraw-Hill, 800-227-0900; ISBN: 0-07-882083-9.

Circle 515 on reader service card







Managing computers on a network requires knowledge, skill and a bit of intuition.

Introducing the new Compaq Deskpro

Okay, a lot of intuition.

Somehow, you have to know what's going to happen. Before it actually happens.

Wouldn't it be great if you had just a little help?
A crystal ball? A sixth sense, perhaps?

Funny, we were thinking the same thing. Which is why we built the new Compaq Deskpro®. A com-

HAVE COMPUTERS BECOME MORE HUMAN?
WELL, THIS ONE CAN TELL YOU WHO IT IS,
WHAT IT'S DOING, AND HOW IT FEELS.

puter that can actually send a report of its status directly to the desk of the network administrator.

Imagine being warned before a hard drive on another floor (or another city) seized up. Or taking a complete PC inventory right from your desk. (Certainly not the kind of cooperation you'd expect from a machine.)

We call it Intelligent Manageability. You'll likely call it "I'm glad someone finally thought of that."

How do we know? Maybe it had something to do with intuition.

COMPAQ

Research proves what you've known all along: only 20% of the lifetime cost of your company's PCs is the initial cost.* The other 80% comes from all the things you do to manage them—like configuring, servicing, upgrading and just keeping track of who's got what. Isn't it time someone found a way to change that?

Asset Management 101. Our newest Compaq Deskpro is the first PC that's as concerned about cutting costs as you are. It all starts with the Intelligent Manageability we mentioned a page

LAN management, we built in some powerful features that can be tapped by their new software tools.

And the result is stunning: Now, as network manager, you can look into a Deskpro PC anywhere on the network to take inventory. You can retrieve hardware specifications, including make, model and serial number for the PC, hard drive and monitor, and revision numbers for the system board and ROM. You can also identify system software and drivers.

It's not only good knowledge to

critical potential problems before they can turn into real ones.

Every time you power up the new Deskpro, its IntelliSafe™ hard drive conducts its own diagnostics. If any of its performance parameters has fallen below acceptable standards, the user is notified. So instead of responding to an emergency, you have ample time to take corrective action—replacing the drive at no expense under the Compaq Pre-Failure Warranty."

In addition, our Environmental Fault Protection constantly monitors

COMPUTERS THAT TAKE CARE OF THEMSELV

ago: a Compaq-designed combination of hardware and software that gives you a new level of control over your networked PCs.

Until now, taking stock of your PC assets has always required you to physically visit your computers one at a time. At every stop, you'd have to examine the PC, take serial numbers, check software, open it up and take a look inside. It's a process that could literally take days.

The new Deskpro changes that. Working closely with the leading companies in the world of

have. It makes the job of maintaining and updating PCs vastly more simple.

Fire prevention. When people decide to stop working for you, they usually have the courtesy to give notice. Computers, on the other hand, seem to enjoy the element of surprise.

Again, Deskpro will be changing things. Its Intelligent Manageability actually alerts

the user to

the internal temperature of your Deskpro to make sure it isn't working under conditions which might imperil your valuable data.

Networking is in our blood. Because setting up a personal computer on a network has turned into one of the most time-consuming pastimes in corporate America, the new Deskpro was built to streamline the process.

Right out of the box, it's configured for your network, with a 32-bit PCI Ethernet NIC or an IBM Token Ring adapter



Introducing the latest line of Deskpro computers

already installed. The drivers are optimized and industry-standard connectors are in place. And with its simple configuration tools, Deskpro helps reduce the complexity of setting up desktop network software.

Under the hood. The thing that makes our Intelligent Manageability most appealing, of course, is the fact that it's built into an enormously powerful and efficient computer.

With Deskpro, you can choose your processor, from a DX2/50MHz to the most powerful Pentium. And

of built-in Enhanced Business Audio.

Open and accessible. Needs change, goals change and people change. The good news is, a Deskpro computer can change every bit as quickly.

It opens without any special tools. The system board slides out, making it easy to upgrade the processor or add extra RAM. The PCI expansion slots are easily accessed. And the drive cage swings out to make hard drive upgrades painless.

Plus, the Deskpro system board utilizes Flash ROM technology, which

single Deskpro probably won't finance your retirement villa, but the savings from many machines over many years should have a nice effect.)

And when Windows 95 becomes available, Deskpro will make the job of managing your company's network of PCs even easier.

Using new management software tools provided by Compaq and our LAN industry partners, you'll be able to effectively monitor the health of all your networked Deskpro PCs—including the ones hard at work in

ES? THIS COULD TAKE SOME EXPLANATION.

every model delivers the enhanced performance of Compaq's new TriFlex™/PCI architecture. In fact, in our latest crop of Deskpro PCs, higher performance is something you can literally see and hear.

Thanks to PCI local bus graphics, you get crisp, responsive graphics even in everyday business applications. (Select 586-class Deskpro models are available with higher-performance VRAM graphics.)

In multimedia models, you get the speed of our new QuadSpeed CD-ROM and the CD-quality sound

allows you to make future upgrades at the board level simply by running a software utility.

With the task of upgrading a PC reduced to minutes, you can allocate your time to more lucrative pursuits.

Future dividends. And then there are the benefits your business will be reaping down the road.

Since all Deskpro models have been designed with built-in power management features that meet the EPA's stringent requirements, they can actually consume less power.

(The savings in a month from a

your outpost six time zones away—without having to leave your desk.

You'll be able to configure your Deskpro so that if IntelliSafe hard drive failure becomes a possibility, it will send you a distress call across the network. Or automatically safeguard its data on a tape backup.

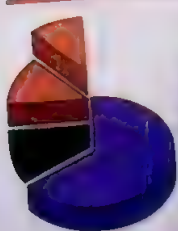
You'll even be able to have Deskpro send remote notification if it should detect potential problems with its built-in network interface card or internal operating temperature.

But then, what do you expect from a computer that takes care of itself?

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To: All Sales Representatives
 From: Kenton O'Keefe
 Sales Manager
 Subject: Persuasive power of color presentation

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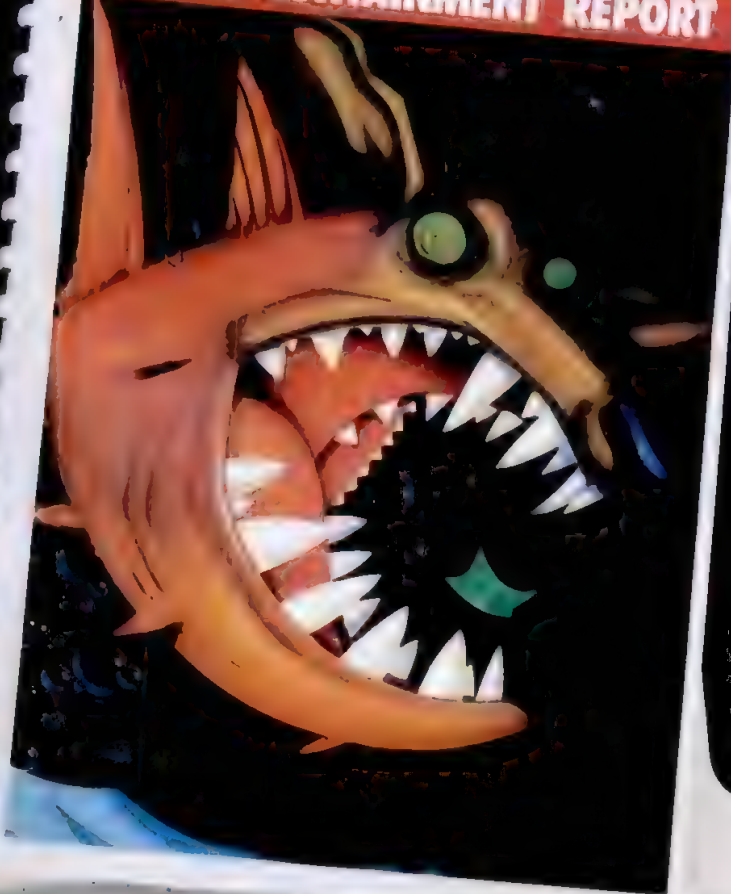


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COST CONTAINMENT REPORT



Business Color Print

COLOR PPM



COST PER PAGE



PRINTER PRICE



Tektronix

Color is color, unless it's brilliantly practical.

It's the business printer you've been waiting for. Professional color so reliable, inexpensive and easy to use, it's a practical office tool. Speed? It's the world's fastest desktop color printer at 4 color pages per minute. Cost? Full text pages on plain paper at 3¢ each. Color for 11¢ on office papers. Simplicity? If you can load a stapler, you've mastered this machine. Reliability? Add 700 sheets and let

it run overnight. That's robust. Price? At \$4,995, nothing in its performance range even comes close. Best of all, it's from Tektronix, a Fortune 500 leader, making world-class color printers for 13 years.

The Phaser 340 Color Printer.
 So practical, it's brilliant.



Free print sample and nearest dealer, call 800-833-8100, Ext. 1343.

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Tektronix

CIRCLE 001 ON READER SERVICE CARD



Michael J. Miller

IBM's Three Battlefronts

Once the most unstoppable force in the world, the Big Blue army finds itself on a cold Northern plateau, confused, outgunned, and surrounded. On the Western front stand the fearsome Windownites. Formerly allied with the Big Blue army, this well-

armed legion is determined to do one thing—dominate. Bivouacked on the Eastern front are the less aggressive though very focused Lotusputians. This outfit knows exactly what it wants. From the south, the Oracleians approach. Perhaps the pack most threatened by the Big Blue army, the Oracleians—who are almost as focused as Lotusputians—show the most outward aggression.

The Big Blue army's generals face a tough decision. In fact, their survival depends on it. Should they split up their forces—which are still formidable—and engage all three fronts, or should they pick one opponent and attack with total abandon? If they choose the later strategy, which group do they attack?

TIME TO PICK A FIGHT

That's the situation I believe IBM Software is in today. IBM has tremendous resources. IBM's total revenues in 1994 were about \$64 billion, with its software revenues totaling about \$11 billion. That's more than twice those of Microsoft (almost \$5 billion). But according to a *Wall Street Journal* article, IBM's software revenues are largely derived from platforms other than the PC. Here's how the \$11 billion breaks down (in billions): \$6.1 for mainframes, \$2.9 for minicomputers, \$0.9 for PCs, \$0.86 for workstations, \$0.44 for networking and other platforms. The \$0.9 billion in PC software sales includes Microsoft Windows software resold with IBM PCs.

I think IBM has to choose one battle. It can be the client/server software company and take on Oracle; it can be the messaging company and set upon Lotus; or it can decide to be the operating-system company and cross swords with Microsoft.

To have the kind of relationships it wants with its

major customers, I think IBM needs to be seen as the provider of at least one strategic software layer. Others at *PC Magazine* disagree with me. Editor Robin Raskin, for instance, thinks that pushing all three software strategies brings IBM a level of synergy. I believe pushing all three means that none of these areas will come across to users as strategic, and as a result, IBM won't lead in any of them.

That's where IBM's competitors are clear. Microsoft has a lot of products (and actually gets more revenues from Office applications than anything else), but its strategic direction is in operating systems, and its key product is Windows 95. Oracle may be branching out, but its focus remains client/server and its key product is its database. Lotus still gets most of its revenues from desktop applications, but there's no question that messaging is its strategy and Notes is its key product.

THE WAR OF CLIENT/SERVER

IBM's traditional strength has been with large customers, all of which have huge databases. In fact, IBM effectively invented the client/server database, and I believe more data is probably stored in DB2 than in any other database

format. Then why do people think of companies such as Oracle, Sybase, Informix, Ingress (CA), and even Microsoft before thinking about IBM in the client/server arena? Because IBM didn't have creditable databases in the open systems and PC world until after its competitors did. Also, IBM has never made a big push towards positioning itself as a client/server company from a software angle.

If IBM chooses this battle, its key product will be DB2. IBM needs to get its database on all platforms and on all operating systems. It needs to play up its



IBM's back is to the wall. The company is surrounded by more focused and more aggressive competitors.

Michael J. Miller

development tools (from C Set++ to Visual Age to Visualizer), its behind-the-scenes infrastructure (such as Message Queuing), and its network services (such as LAN Server) as the best ways to store and access information.

In this way, IBM would be playing to its greatest strength: its relationship with large customers. It will face tough competition from Oracle, Sybase, and the like, but IBM is used to tough competition in this market.

THE FIGHT FOR E-MAIL

Messaging—e-mail and beyond—may be the most wide-open market of the three. Just about everyone agrees that e-mail is a strategic application for the nineties, and it's growing at a phenomenal pace. We're moving beyond simple e-mail, adding more sophisticated messaging features such as moving transactions, workflow, and replication abilities. All four of the major players in this arena—IBM, Lotus, Microsoft, and Novell—are in the midst of revamping their

strategies and products (see "Four Paths to Messaging," April 25, 1995).

If IBM were to choose messaging as its core strategy, then the key product would be the upcoming Workgroup client/server mail and messaging software. Other pieces of IBM's software could fit into this strategy as well, including MQ (Message Queuing, which ought to be a feature, not a separate product), DB2 (where the data could be stored), and OS/2 LAN Server or Warp Server. Lotus would be IBM's biggest competitor, with Novell and Microsoft not far behind.

THE OPERATING-SYSTEM SCUFFLE

The biggest win, though, would be for IBM to capture the operating-system market, at least in the large corporate arena. This would provide a great platform for other applications and would weaken Microsoft's hold in proportion to any gains IBM has.

IBM's key products are OS/2 Warp and OS/2 LAN Server, running on multiple platforms. Its key competitors are Microsoft and Novell (NetWare is nearly as dominant in the network operating-system world as Windows is in the desktop world). It's a tougher fight, because Microsoft and Novell are so

well entrenched, but the victory would be sweet and the spoils enormous.

Until recently, IBM hasn't wanted to choose. Different divisions are responsible for different things, and each pushed its own product to the point where the message was sent that none of the products were really strategic. Consider this: Last fall I got a briefing from IBM senior managers saying that OS/2 was the strategic OS for the PowerPC Platform. The very next week, an IBM senior executive said at a public announcement that all operating systems for the PowerPC were equally important. He recanted this statement a week later. When IBM ships with Windows NT, which now seems likely because OS/2 won't be ready, it will be interesting to hear the explanation.

IBM needs to pick one software strategy. Once this decision is made, IBM must rally all of its divisions to stick to this one strategy. This doesn't mean that IBM should abandon its other products. Everybody has tactical products that hopefully end up reinforcing the big strategy, such as Microsoft Office or Lotus SmartSuite.

I think IBM will pick the client/server strategy. But what matters most is that IBM pick a fight and follow it through to the end. □

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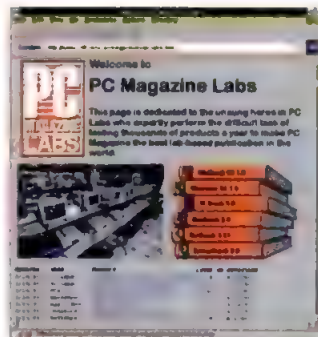
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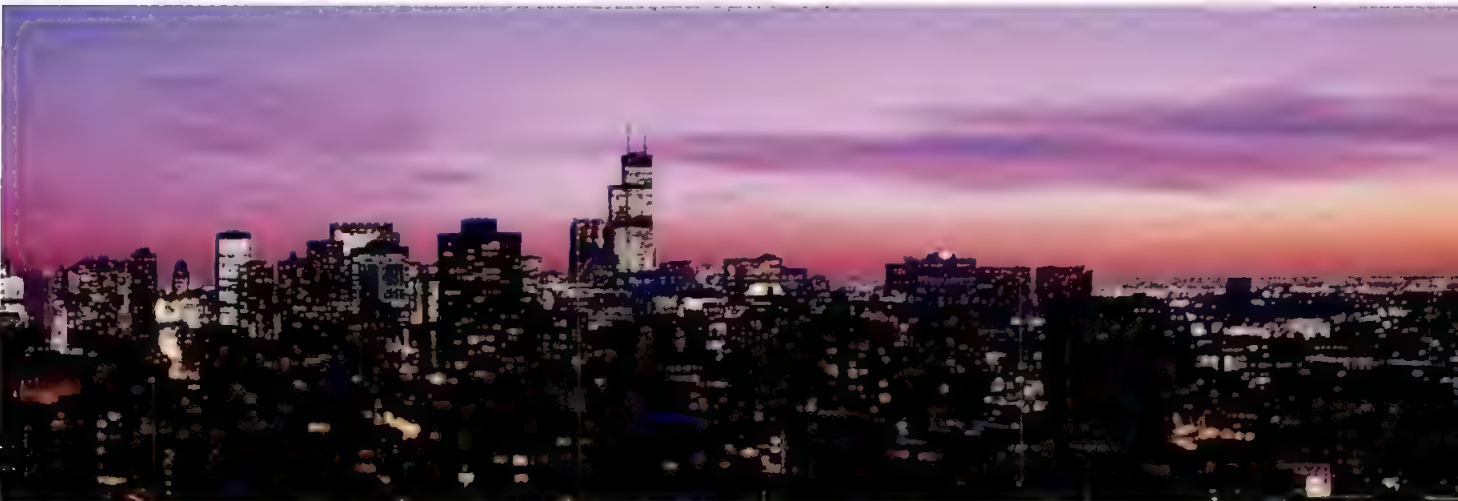
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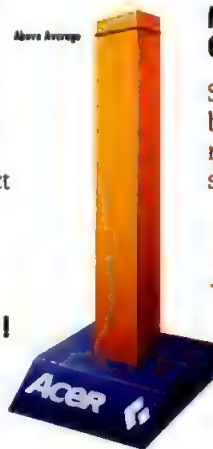
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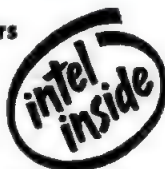
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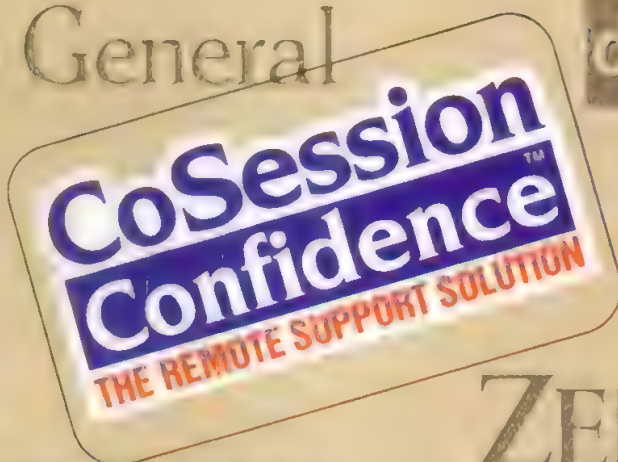
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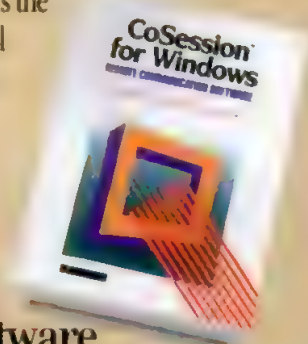
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Bill Machrone

MUDs and MUSHes and MOOs

Life in cyberspace has always been strange, but strangeness can be nothing more than the unexplored space between what you know and what you don't know. The human mind has amazing categorizing and organizing powers, which save you the effort of

having to react consciously to things that are familiar and comfortable known quantities. When it encounters things that are strange or beyond its experience, it dishes up reactions such as hostility, revulsion, and contempt. Curiosity comes much later, after your brain is sure about your own safety.

Many of the critics of cyberspace are not yet comfortable enough with the goings-on there to be curious. Even those of us who are in the business of assimilating and explaining change can be temporarily overwhelmed by it.

Technology itself can be perceived as a threat by those who haven't made the effort to understand it or stabilize their relationship with it. For example, a woman I'll call Grace (because she evidently lives in a state of grace untouched by the realities of the 1990s) spoke out against the use of computers in schools recently at a school board meeting. "And they have *spell-checkers*!" she spat, with distaste and vituperation. Grace is obviously threatened by computers if she reacts so violently. I'm not sure what the stakes are for her, but they must be pretty high.

The kids, meanwhile, are contemptuous of teachers, coaches, and advisors who don't use technology. My teenage daughter and her friend were laughing recently over an error-ridden hand-out: "He didn't even use a *spell-checker*! It's a wonder he can use a computer at all!" Borderline disrespect, perhaps, but right on target.

We also have the misguided attempts at legislation aimed at making cyberspace a safer place for our children. Only our kids, and what they've learned from us, can make cyberspace safer. My 9-year-old son reads a couple of Usenet newsgroups that focus on Magic, the card game. He pointed out a series of messages from one user and mused: "I wonder why he uses so many curse words.

Probably a teenager who wants to sound older." Thus he captured an essential irony of growing up: We clean up our language around the kids so we're not a bad influence, and they cuss like sailors' parrots when we're not around to sound more mature. No legislation can change fundamental truths such as this. All we can do as parents is offer perspective, information, and a few ground rules.

You'll need perspective aplenty to comprehend the constantly evolving on-line world. Gamers, for example, were quick to move their Dungeons and Dragons fantasy games on-line, creating MUDs (Multi-User Dungeons, or Multi-User Dimensions), MUSHes (Multi-User Shared Hallucinations), and MOOs (MUD Object-Oriented). These on-line worlds are like participatory novels. A few dedicated gamers stay up around the clock, afraid to miss any of the action as the game unfolds. Fearful, uncomprehending detractors spin exaggerated myths and dangerous generalizations about them.

If fantasy worlds are too weird for you, brace yourself for the Next Big Thing in on-line services: avatars. Soon you'll be able to chat and interact with people on-line through your own graphical simulacrum. You get to choose the sex and appearance of your on-line avatar,

and it responds to your directions with body movements, gestures, and facial expressions. You'll be able to buy and furnish an apartment in these virtual worlds, and you'll be able to invite others over for a private chat.

Cyber-conversations, in all their infinite variety, are here to stay. If you're not in tune with this world, don't be too quick to judge those who are. You may think their lives are impoverished through lack of human contact, but they've found a world that for them is rich with expression, interaction, and emotion. □



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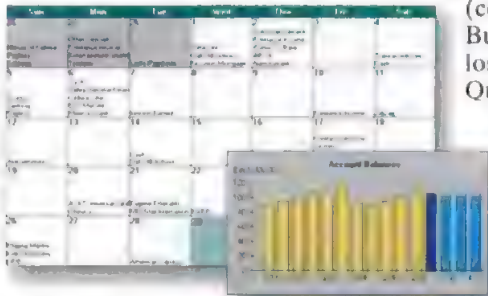
Second Looks

LIVING WITH THE PRODUCTS WE REVIEW

Who's Afraid of Quicken for Windows?

Intuit's Quicken product line has moved from being one of the most unremarkable to being one of the most controversial. Quicken for DOS defined the personal-finance market quietly and competently. But as the GUI market developed, users clamored for a Windows version.

Second Looks mail has been running about two to one against Quicken for Windows, with most of the complaints addressing slow per-



formance and a less graceful user interface. To Intuit's credit, it has willingly let dissatisfied users trade for the DOS version. "I am simply not pleased with the amount of work I have to go through to record a single check transaction," says one Quicken for Windows user. "Like a true cult member, I wander the world spreading the gospel of the perfection of Intuit," says another. But even the true believer complained about a bug in back-dating stock

transactions that has persisted since Version 3.0.

The bottom line: Stick with a DOS version of Quicken, unless you have a DX2 or faster machine or the patience of a Zen master. Also, watch out for irritants such as the "account balance" bar graph in the Financial Calendar that doesn't match the amount in the register.

Some users say that Auto Backup doesn't work on their systems and that Intuit's technical support has been unresponsive. By the way, if you need to track accounts in multiple currencies, you'll need the (costlier) British version. But with that release, you'll lose the CheckFree and Quicken Quotes features.

Of course, the TurboTax calculation-error debacle is history, but users are still complaining about problems with importing data from Quicken for Windows. One user's solution to this problem: Trade in the DOS version and enter the data manually.

I was wrong about Quickbooks' inability to print multiple checks (and so, sadly, was the on-line tech support): You can print only one check at a time from the register. But if you've got the "To Be Printed" box checked, Quickbooks queues up all the checks for batch printing, as with its other on-screen forms.

Windows Uninstallers? Theory vs. Practice

Remove-It, from Vertisoft Systems, has an excellent manual that gives a thorough explanation of the complexities of removing Windows programs. The program, however, cannot properly deinstall products such as

Ares's FontMinder, nor does it remove unused fonts properly.

Users report that other programs, such as WinCIM and Microsoft Word, get flaky even after Remove-It. MicroHelp's Uninstaller 2.0, or Quarterdeck's CleanSweep handle them correctly. Uninstalling programs will never be perfect until all software uses a registration database. Some products with an uninstall feature can't even remove themselves correctly.



Lotus Gives You More of What You Didn't Want

Lots of people use Lotus Organizer 2.0, but I couldn't find anyone who had nice words for it. The litany goes like this: It's bigger, slower (*much* slower), bug-ridden, and missing some highly desired features, such as the ability to change font characteristics, synchronize multiple (home and office) calendars, and easily manage dial-in support for mobile users. (Version 1.0 knew how to handle outside lines properly, but 2.0 forgot.)

Not only did Version 2.0 fail to import its 1.0 files correctly, but it bloated them to the point where you couldn't fit them on a single floppy disk. Beyond the stunning lack of backward compatibility with Version 1.0, users complained about clumsiness in handling recurring appointments and an inability to set a priority preference for home or office.

Despite all of its faults, Lotus Organizer 2.0 does what it's supposed to do, however ponderously. And the program really works in a multiuser environment.

Some users think that a warmed-over Organizer could be a terrific front end for the entire Lotus suite; others think you should skip it and try Ecco Professional.

LOOKING AHEAD

Tell me what you love and hate about these products and we'll share the information in future issues.

Autodesk 3D Studio	Quad-speed CD-ROMs
Diamond Stealth 64 Video	Vertisoft Remove-It
IBM ThinkPad 755CD	Toshiba Portégé T3600GT
LANtastic for OS/2	WordPerfect 6.1
PCMCIA modems	ZDS Z-NoteFlex

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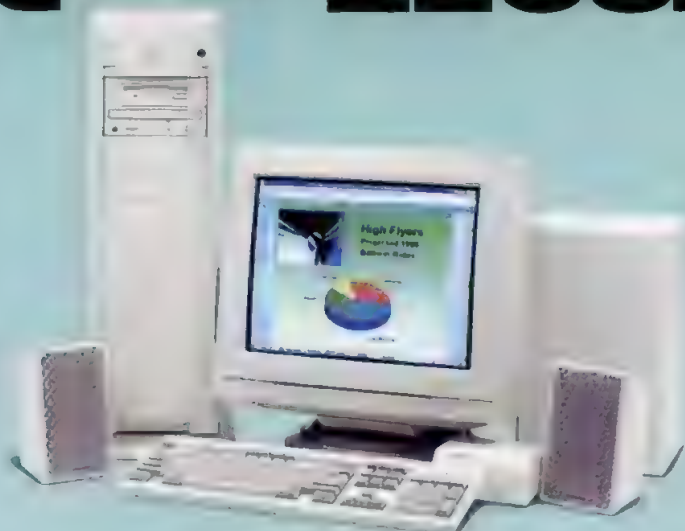
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- Microsoft Mouse
- Microsoft DOS 6.2, Windows for Workgroups 3.11
- Lotus SmartSuite



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John C. Dvorak

Windows 95 vs. OS/2 Warp

I got onto a new machine and for a few seconds—or maybe even a minute—I was certain I was using an OS/2 system, only to discover that the PC was running Windows 95. While Windows 95 seemed slow to me, I could see that this operating system was

not going to be as annoying to use as today's Windows. It's a lot more like the Mac. It's a lot more like OS/2. It's bound to be buggy as heck, and I'll probably stick with OS/2 in the near future, but I'll eventually go for Windows 95. When that happens, I'll probably end up using Boot Manager, V-Commander, or some such thing so I can run various operating systems as needed.

As an aside, let me say that users shouldn't be restricted to running a PC with one OS at a time. I'd love to run two or three in different windows. This was one of the ideas behind the fading Workplace OS that IBM was pinning its operating-system hopes on. One OS kernel with multiple personalities—Windows, OS/2, and Unix—was the idea. It was also the dream of virtual operating systems modeled after IBM's VM.

This approach to computing will not come to pass as long as the Intel processors can't self-virtualize. In other words, the CPU can't pretend to be copies of itself and run different operating systems. Current designs don't encourage two or more operating systems running at the same time via the kind of artificial hook that OS/2 has for Windows 3.1. As long as we are using the current platform, we're stuck with using one OS at a time. For most people this means running the standard OS, simply for the apps. Spell it W-I-N-D-O-W-S.

Speaking of standard operating systems, it's not impossible for OS/2 to become the next standard. Anything is possible when a company does things right. Intel, for example has seemingly aced the VESA VL-Bus out of the picture in the competition with the PCI bus. The VL-Bus was an overnight standard that got bumped almost as quickly. Being there first just doesn't always prove fortuitous. The VESA people didn't have

the muscle to keep their standard as *the* standard.

Alas, IBM controls no PC standards that it can leverage. And it doesn't even have the software to back up its own OS. When the IBM PC first came on the scene, within two years the company was the number-one software vendor—not Microsoft or Lotus. When you went into the IBM store, there was a slew of IBM-branded software products. A decision was made by some genius in a blue suit to dump the stores and phase out the branded software. I always thought getting out of the retail business was the beginning of the end for IBM. Why give up the cross-marketing advantage they had between software and hardware? The company has since become just another one of the seven dwarfs in the hardware business, and at some point it will have to admit that OS/2 itself is only continuing because of corporate pride. If OS/2 can't run Windows 95 within 12 months of the release of Windows 95, then it will not survive except as a niche OS for servers or for some odd vertical applications.

It's not just the Windows 95 versus Warp battle that will be over. Hardware-standards battles will end, too. I'm personally so tired of fighting with sound cards and OS/2

that I'm only going to use Creative Labs cards. Maybe Plug and Play will end the misery, you say? It won't help if you want to play DOOM or some other DOS game. I'm also getting a little spooked by IDE-2 and the video-card circus, where many cards simply don't work well. Once upon a time there was the VGA standard, and there was compatibility for all.

At some point we have to ask ourselves exactly what the most standard system we can piece together is: It has everything we need and runs fine. That day of decision is quickly approaching. Things are going to get pretty dull when it passes.



*Users shouldn't be
restricted to running a PC
with one OS at a time.*

John C. Dvorak

Inside Track

Get Ready to Rumble Dept.: Finally, look for the incorporation of the digital signal processor (DSP) **chip into the base architecture** of the PC. It's Intel's intent to get designers to use their evolving NSP (native signal processing) concept and put the power of a DSP (Intel designed, of course) on the motherboard of all future Pentium machines, as well as designs like P6, P7, and so on.

This idea is nothing new and was actually part of the NeXt computer design when it was first shown years ago. The fact that it has taken this long for a **native DSP** to be incorporated into the computer itself is kind of **amazing**. But count on it happening. The way Intel sees it is that there are too many modem chips and sound chips and fax chips and who-knows-what-else chips being sold for add-in cards.

A native DSP on the motherboard will turn modem companies and sound-card companies into employment counseling centers overnight. Either that or the smart ones will start producing software to run DSP applications. The fact is that sound and most telecom functions will be done off the native DSP in the future. It will be **applauded** by those of us who have suffered trying to install incompatible sound systems.

Now, the Bad News Dept.: While it appears friendly and smiley (as in BOB), Microsoft would still love to get out from under Intel's **domination**. So, it's trying to promote a different native DSP standard, called MSP. This is based on the work being done by a company called MicroUnity, which is developing some sort of **super-duper killer DSP**. Intel, of course, will jump start its NSP design much the way it promoted the PCI bus, by manufacturing OEM motherboards and full systems, and having the likes of Insight, Gateway, and other big computer sellers attach their names to the boxes and sell them as their own. Microsoft should give up in this competition.

A Free Electronic Service You Need Dept.: Industry Pioneer Jim Warren has been sending out an electronic newsletter called GovAccess for what seems like years. Are you on the list? You should be. He combs through various reports and spreads the word about **dangerous legislation**, among other things. Recently he seems to be the **only one** concerned about a rider attached to the Telecommunications Reform Act of 1995 that expands a **weird** and little-known law **banning profanity over the phone**. That U.S. Code (47USC223, 1992) essentially makes it illegal for anyone to cuss over the phone. Curiously, it makes a special

*I suspect the result of the
Exon amendment will be
that a lot of BBSs will be
shut down, in addition to
the Penthouse and Playboy
Web sites. Individuals
sending sexual .GIF files to
each other could get into
trouble, too.*

exception for commercial **phone-sex** operators! Meanwhile a husband and wife can't legally be intimate in a phone-sex way even if joking around. Eeeeh. It's creepy. It's sick. It's gone too far.

Warren points out that this law is being expanded by Senators Exon (D-NE) and Gorton (R-WA) in Senate Bill 314, which is called the **Communications Decency Act of 1995**, to include all forms of telecommunications devices, specifically modems. I wish this were a joke. In other words, the CompuServe CB Chat, AOL People Connection, and the Internet IRC will no longer be able to have any open or private discussions that stray into intimate territory. The law is written with a local-community-

standards angle, which is meaningless in a global telecommunications environment. Right now, publication of a **cuss word** on-line is a violation in certain communities.

I suspect the result will be that a lot of electronic **bulletin boards will be shut down**, in addition to the *Penthouse* and *Playboy* Web sites. Individuals sending sexual .GIF files to each other could get into trouble, too; Exon tried last year to sneak this onerous provision into the Telecommunications Act, but the act itself was **rejected** for other reasons. This year it looks as if it will get in. The fine is up to **two years in jail and \$100,000 for a violation**. Warren outlines all the aspects of this idiocy as well as other attempts by Big Brother to crush the Internet. Please check this out and contact Senator Exon's office to complain.

I could go on and on about the Telecommunications Reform Act itself and how it will do more harm than good, but Warren reports on it better. Subscribe to his newsletter. The mainstream news media seem oblivious to things like this and would rather **cover the O.J. Simpson trial**.

Send e-mail to jwarren@well.com and put the word "subscribe" in the subject line, as well as in the body of the text of your message. He'll put you on his list so you can be **appalled on a regular basis** by what's going on in Washington. Our leaders are **bigger boneheads** than you ever imagined.

Expensive but Necessary Newsletters Dept.: While the Net still lives, we could do worse than subscribe to the Internet Business Report. Not for the faint of heart at \$279 for 12 issues, this 12-page newsletter will keep you **up to snuff** on the Internet business scene. Anyone thinking of using the Net for transactions or who has a money-making scheme should subscribe. Call 516-562-5000. While the Net lasts, this should be good reading. □

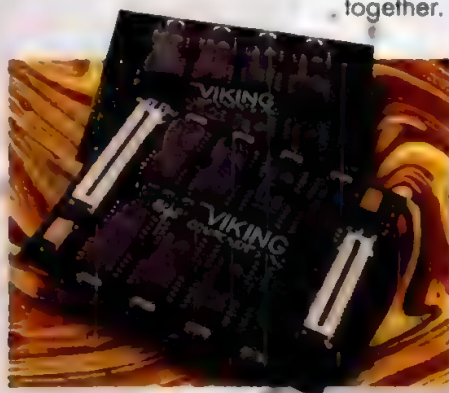
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Jim Seymour

From Darkroom to PC

There's a widely accepted link between an interest in music and an interest in computers. I've come to suspect there's also a less noticed but similarly strong link between an interest in *photography* and an interest in computers.

The explosion of the personal computer market in the early eighties whacked the photo business hard. Photo enthusiasts by the millions stopped spending money on new 35-mm cameras and lenses, darkroom equipment, and supplies. Many poured those hobby dollars into PCs, and while they didn't necessarily stop taking photos, many spent so much time at their new PCs that there wasn't much time left for picture taking. The arrival of tiny, high-quality video cameras compounded the problem. Amateur still photography wasn't quite dead, but it was hurting.

Photographers who had discovered computers were soon able to combine their interests, with the advent of such products as Adobe Photoshop, Micrografx's Picture Publisher, and other photo-editing software. They also benefited from reasonably priced desktop color scanners and Kodak PhotoCDs—all tools for getting images into the computer to be manipulated.

THE GOING GETS TOUGH

There were several problems. Though the power of Photoshop and Picture Publisher remains unquestioned, these packages are really meant for prepress work: getting images ready to be published in newspapers, magazines, and annual reports or on boxes and billboards. They are intended for use by publishing and graphic-design professionals, which means that they're difficult—sometimes *very* difficult—to learn. It also means that they're keyed toward turning out color separations for publication, not photographic prints to hang on the wall or mail to grandpa.

While even the toughest computer program can be mastered, the steep learning curve of these packages was discouraging to most

photo buffs. And when they learned that they couldn't get prints of the sort they picked up at FotoMat or Back-in-a-Flash, they soon gave up.

Now the amateur photographer who's also into computers—from the weekend snaphooter to the serious photo buff draped in Nikons—is able to combine both interests much more reasonably, thanks to two new software packages.

Digital Light and Color's (DLC) Picture Window is aimed more toward the serious photographer who wants high-quality photographic prints. Picture Window 1.1, a new and more capable version, has just shipped; at \$99, it's half the price of the original. Picture Window still demands a 486 or better PC with at least 12MB of RAM, but this new version is a much more versatile product because you can get TIFF or .BMP files out of it for creating screen savers or newsletters.

If you've never worked with photo-editing software, Picture Window will knock you out. Using your own scan or a PhotoCD image, you can crop or resize images; dramatically shift density, contrast, and color values; eliminate dust and scratches; and even correct perspective. Few PC software packages are as much fun to use as Picture

Window, or deliver such satisfying results.

MASTERPIECE BY MAIL

When you've finished editing your masterpiece, you copy the resulting file to a floppy disk and mail it to DLC's service bureau, which returns 6- by 9-inch (\$8.95) or 9- by 12-inch (\$14.95) prints of exceptional quality. Prints are made on a Fuji Pictography 3000, a costly high-tech printer that produces true photographic images on heavy, glossy, silver-based paper. The Fuji prints recall Cibachromes but don't have the same extraordinary longevity.



Amateur photography wasn't quite dead, but it was hurting—thanks in part to the exploding PC market.

Jim Seymour

If you're a fairly serious photographer who hasn't done much with the medium lately, give DLC a call (800-577-7090) and ask for the company's free Picture Window brochure on CD-ROM.

SCAN-'N'-PRINT

The second new product is aimed at the more casual photographer. Rather than turning out photo-quality prints, it's intended to help you scan your own photos and then print them on any of the popular low-priced color printers available today.

EasyPhoto, from Storm Software, is a \$95 software package. But for \$249, you can get EasyPhoto bundled with a small scanner, the EasyPhoto Reader, which handles up to 4- by 6-inch prints. A hand scanner mounted on a base, it produces good scans quickly.

With your pictures in the computer, you can apply the usual photo-editing tools in EasyPhoto's Photo Workshop, save the modified images, then either print them by themselves or—and this is a lot easier than you'd expect—drag and drop them into letters to Aunt Jane and Uncle Dave.

The folks at Storm say their package delivers improved results from your printer, thanks to its enhanced ClearPrint algorithms—and they're right. I was knocked out by the quality of EasyPhoto images when I printed them on a Hewlett-Packard 1200C and a Canon BJ-4000C.

EasyPhoto is much more of a hobbyist's tool than Picture Window is. While EasyPhoto's image-manipulation controls are more limited than those in Picture Window, they're perfectly suited for the person who wants to drop a couple of quick snaps into a computer-printed document.

And though dropping family snapshots into letters to grandma may be the most obvious use of EasyPhoto, it has many other uses as well, from preparing illustrated household inventories to kids' school reports. It's suited to such business uses as creating limited-distribution catalogs of crafts goods, real estate agents' handouts describing homes for sale, and insurance investigators' reports.

A demo CD-ROM of EasyPhoto is available directly from Storm (800-275-5734).

So dig out that dusty SLR and start shooting again. You'll love working in the new color-photo darkroom, and you won't get lightheaded from inhaling lots of developing chemicals. □

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Bill Howard

Hitting the PC Sweet Spot

We're awash in options. With 60-, 66-, 75-, 90-, 100-, 120-, 133-, and shortly 150-MHz CPUs, we have eight choices in Pentium processors alone—not to mention offerings from AMD, Cyrix, and NexGen. Here's my take on where the sweet

spot of the PC market stands today, based on discussions with virtually all the major PC and CPU vendors, plus recent PC Labs tests of 100 Pentium PCs (see "Tapping the Promise of the Pentium" in this issue).

As of midspring, the touchstone price—cheap but not cheapest—is \$1,999 for a Pentium/75 multimedia system with 8MB RAM, a 700MB hard disk, and a 15-inch monitor. Prices have dropped nearly \$500 since late winter because of another Compaq-inspired round of price cuts and the arrival of the 120-MHz Pentium, which pushed each CPU price (and system price) down one notch.

If you're bottom-feeding, you could pick up a non-multimedia Pentium/60 or Pentium/66 system for \$1,500. The 5-volt CPUs run warm; I wouldn't want one in my system, given the alternatives. You'd be better off with a 486DX4/100 PC: It gives you performance equivalent to a 66-MHz Pentium, and it runs cooler.

Among Pentiums, 90 MHz versus 100 MHz is a non-issue to me. The performance difference isn't something you'd notice except with a benchmark test, which means it wouldn't change how you deploy your PCs in business. The average price difference for system vendors has dwindled (\$673 for a 100-MHz CPU versus \$546 for 90-MHz, instead of late winter's prices of \$905 versus \$587), but there are other costs that won't go away. The CPUs run at 1.5 times bus speed, and 66-MHz bus designs are rarer than 60-MHz designs. You also need faster (costlier) static RAM for the 100-MHz Pentium's CPU cache. When Intel develops fraternal-twin CPUs—60 and 66, 90 and 100, and now 120 and 133 MHz—the second one arrives just in time to be upstaged by the next iteration. Next stops are the Pentium/150 and then the next-generation P6 at 133 MHz.

If you want to do one

thing to speed performance, spend an extra \$300 for another 8MB of RAM. On Winstone 95, we found a 50 percent increase in many cases with 16MB Pentium systems. The gain going from 16MB to 32MB, however, is marginal.

EDO memory may do away with some L2 caches. EDO or *extended data out* RAM boosts performance about 5 percent. On entry-level 75-MHz PCs, some vendors will be able to use EDO memory (which by summer will have a zero cost increment over standard DRAM) rather than the combination of fast page-mode DRAM with L2 cache.

Gigabyte drives are for everyone. They're as little as \$399 at retail, even less built into a PC. Multigigabyte drives can change the way you think about your PC. With that kind of storage, you could do optical imaging at work. At home, you're on the cusp of being able to edit video. If you are in the market for backup, look for the price of DAT drives to plummet at year's end.

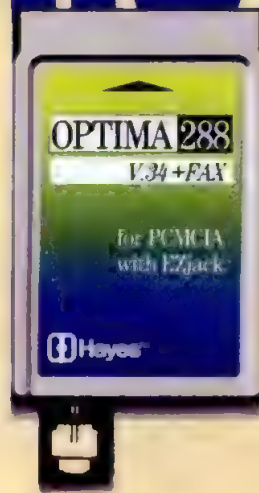
Quad-speed CD-ROM drives are a given. Manufacturing cost is now just \$25 more than a double-speed. You want a CD changer. Gateway 2000, for instance, has an early lock on the production run of an internal, three-CD, quad-speed changer that is only \$100 more than its one-holder.

If I were buying a PC this spring, I'd get this: a Pentium/90 mini-tower, 16MB of RAM, a 1GB hard disk, a 17-inch 1,024-by-768 monitor, 2MB to 4MB VRAM graphics adapter, a multimedia kit including two quad-speed CDs or a quad-speed changer, a V.34 modem (28,800 bps), and a three-year warranty. It would be under \$3,000, and an aggressive vendor might hit \$2,500. A year ago this was a \$5,000 system. In a year, it might be \$1,500—with a faster CPU. Don't you wish new car prices followed this curve? □



When shopping for a PC, pick up 16MB of RAM, a GB hard disk, and a quad-speed CD-ROM drive.

NO COMPARISON



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NETWORK EDITION

COVER STORY

SMALL-BUSINESS NETWORKS

Breaking Through

They're not just peer-to-peer anymore. The world of network software is changing, and these products are in the thick of it.

By Steve Rigney

Survival pressures force evolution, from the wilds of nature to the wilds of computing. Fierce pressures from new products by IBM and Microsoft are forcing the more traditional *peer-to-peer* network vendors, such as Artisoft and Performance Technology, to evolve their products. And evolve they have. These days, it's more appropriate to call these packages and others in their class *small-business networks* to acknowledge what they have become.



Illustrations by James Bozzini



Interpreting the network landscape often seems like trying to read a Rorschach inkblot. The picture looks different to everybody, and each person

focuses on a different part. It's only after you've stared at it for a while, that it begins to move and change shape.

NETWORK OPERATING SYSTEMS are like that. Take small-business networks (that's what we call peer-to-peer LANs these days). In our cover story here, we ask, "Is there a place for the LANtastics and PowerLans of the world in the larger network picture?" We think there is. They've grown into powerful independent networks, but now they also work well as client extensions for the server-based LANs covered later in this issue in "The Versatile Network Operating System."

CONTRIBUTING EDITOR Steve Rigney reports on three market leaders. He's tracked these packages for years from his vantage point as an independent networking consultant in Destin, Florida. He's managed to stay out of the Gulf waters long enough to install hundreds of networks under all kinds of OSs.

BACK TO THAT RORSCHACH: Our First Looks review of UnixWare 2.0 hits an important area for NetWare LANs—their usefulness for applications-heavy networks. Novell emphasizes UnixWare as key to its strategy for NetWare 4.1. We assess what's available in Version 2.0 that would make it part of your strategy.

IF REMOTE ACCESS commands all your time right now, check out our First Looks coverage of the new multiple-CPU boxes from Cubix and J&L. Now is the time to bring that network picture into better focus for your remote users.

—Gail Shaffer

Included With ZEOS Pantera™ Server:

- Intel® Pentium™ processor. ZIF socket.
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- Three PCI and five ISA expansion slots.
- 32-bit PCI local bus SCSI controller.
- Optional on-board PCI local bus Ethernet LAN.
- Flash BIOS.
- 10-bay vertical case with 2 cooling fans.
- 200 watt power supply with built-in surge suppressor, switchable between 115/230V.
- ZEOS 101-key space-saving keyboard.
- FCC Certified Class B; UL Listed.
- EPA Energy Star compliant (75, 90 & 100).
- ZEOS Customer Satisfaction Package.

Package 1

Pentium-75	\$2895
Pentium-90	\$3045
Pentium-100	\$3195
Pentium-120	\$3495

- 16MB RAM
- High-speed 1GB SCSI hard drive
- PCI local bus SCSI controller
- **4X SCSI CD-ROM** drive and 3.5" 1.44MB floppy drive
- **Diamond Stealth 64** PCI local bus SVGA graphics card with 1MB DRAM
- ZEOS 14" 1024 x 768 non-interlaced SVGA color monitor, .28mm dot pitch
- MS-DOS 6.2, Windows for Workgroups 3.11, Microsoft Mouse

Package 2

Pentium-75	\$3695
Pentium-90	\$3845
Pentium-100	\$3995
Pentium-120	\$4295

- 24MB RAM
- High-speed 2GB SCSI hard drive
- PCI local bus SCSI controller
- **4X SCSI CD-ROM** drive and 3.5" 1.44MB floppy drive
- **Diamond Stealth 64** PCI local bus SVGA graphics card with 1MB DRAM
- ZEOS 14" 1024 x 768 non-interlaced SVGA color monitor, .28mm dot pitch
- MS-DOS 6.2, Windows for Workgroups 3.11, Microsoft Mouse

Networking Options:

Intel EtherExpress™ 18
Specify connector. (Ambra only).....\$119

Intel TokenExpress™ 16/4
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ZNYX EtherAction™ 32
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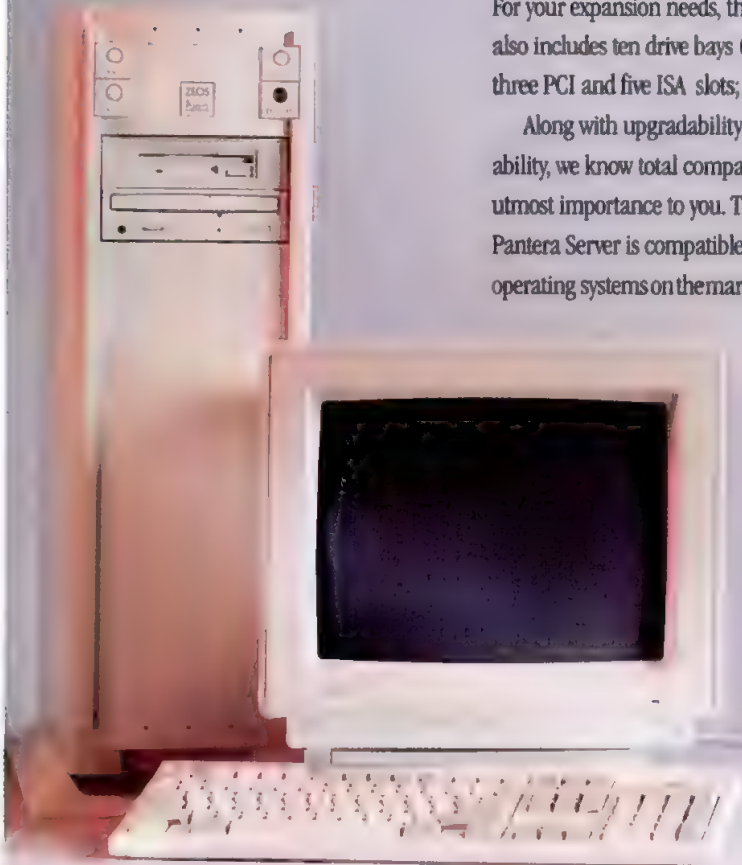
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- ▶ FCC Certified Class B; UL listed.
- ▶ ZEOS Customer Satisfaction Package.

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486DX2-66 \$1195

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- ▶ 3.5" 1.44MB floppy drive
- ▶ On-board VESA local bus SVGA color video
- ▶ ZEOS 14" 1024 x 768 non-interlaced SVGA color monitor, 28mm dot pitch
- ▶ MS-DOS 6.2, Windows for Workgroups 3.11, Microsoft Mouse

Package 2

486DX2-50 \$1,295
486DX2-66 \$1,345

- ▶ 8MB RAM
- ▶ 528MB IDE hard drive, 120K cache
- ▶ 3.5" 1.44MB floppy drive
- ▶ On-board VESA local bus SVGA color video
- ▶ ZEOS 14" 1024 x 768 non-interlaced SVGA color monitor, 28mm dot pitch
- ▶ MS-DOS 6.2, Windows for Workgroups 3.11, Microsoft Mouse

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Traditionally, users have compared these small networks against the large, server-based network operating systems or NOSs (reviewed in "The Versatile Network Operating System" in this issue). But with the impending release of IBM's OS/2 Warp Connect and Microsoft Windows 95, network computing turns from its obvious focus on server software and finally also embraces the importance of client software as well.

Both Warp Connect and Windows 95 will have built-in peer-to-peer capabilities, among many other attractive features. But change has been in the air for a long time now, and many traditional peer vendors, including those in this roundup, have been readying for this scenario.

In this roundup, we look at three leading small-business networks—Artisoft's LANtastic Network Operating System v6.0, Microsoft Windows for Workgroups 3.11 (WfWG), and Performance Technology's PowerLan 3.1—to assess the state of affairs. At the time of our last major roundup of this market segment ("Peer Pressure," April 26, 1994), Artisoft was just releasing a new version of LANtastic (which didn't make it in time for the review). With things heating up in the NOS world, now seems to be a good time to pit LANtastic against the Editors' Choice and honorable mention from that roundup and gauge some of the competition in this part of the arena. Microsoft Windows for Workgroups, of course, will eventually be phased out because of the built-in peer-to-peer features of Windows 95. The uncertain ship date of Windows 95 and Microsoft's resolution to continue selling WfWG after that ship date, however,

Suitability to Task: Small-Business Networks

The role of the small-business network is changing, but some key areas remain important. These packages will continue to play a major role in small businesses—so they must continue to be very easy to use. At the same time, they must be easy to grow or attach to larger networks.

For **file sharing**, we especially look for an easy setup and good security—particularly file-level security. In addition, we feel these packages should have built-in support for both DOS and Windows clients. We also consider file-transfer performance, but each of these products delivers better-than-adequate performance, so it was not a key differentiator.

LANtastic Network Operating System v6.0

Still leading after all these years: Artisoft's LANtastic Network Operating System is easy to use and Version 6.0 delivers the most complete range of features among these three packages, including

all the key criteria that we especially look for. Some of the highlights include good security features for file sharing, built-in support for a range of clients—DOS as well as Microsoft Windows, OS/2, and Mac (the only one here for the last two), an easy installation, solid interoperability with other NOSs, and the ability to scale natively with a 32-bit server. Finally, although performance was not central to this selection, LANtastic led in some of our tests and more than held its own overall.



In our last major roundup of this market, we caught Artisoft in the middle of bringing its new version to market (see "Peer Pressure," April 26, 1994). But we suggested then that this product certainly would have been in contention for that Editors' Choice.

Microsoft Windows for Workgroups and PowerLan are powerful packages, each with high notes of its own. But as a purchase that will grow with you, LANtastic is the excellent choice here.

maintains WfWG's status as a major player in the small-business network market.

WHO WILL THEY ANSWER TO?

The sometimes maligned "peer networks" have become multipurpose tools for businesses of all sizes, but they remain better suited to small businesses. Make no mistake, though. Even in small businesses there's a lot more going on between PCs than just sharing disk drives and printers. People want client/server databases, Internet access, e-mail, and productivity tools—

but they don't want complex management or configuration hassles.

Moreover, though many installations still hover in the 5- to 10-node range, small-business networks are no longer limited to 20 or 30 PCs, nor to one location. Artisoft, Microsoft, and Performance Technology offer small-business networks that accommodate dozens of PCs and also provide excellent upgrade paths for increasing your network capacity, flexibility, and communications capabilities. Each of these products offers acceptable performance, an

Under **printer sharing**, we assess the quality of the printer-management utilities, including such things as where and how error messages are displayed. Class printing is also becoming more important. With class printing, you choose the kind of printer you wish to output to; then the software automatically sends your file to an available printer in that class.

For **installation and management**, ease of use is most important. The install or setup program must automatically update CONFIG.SYS and AUTOEXEC.BAT. We also note the quality of the documentation and whether a sophisticated PC user could understand and follow it easily. In addition, for products that need to connect to larger networks, standard drivers

and cabling are essential.

Interoperability with larger networks requires that the package offer a good range of client

drivers. We consider the client drivers that each vendor bundles with the package. Clients should be able to attach not only to their native servers, but also to NetWare and Windows servers. We also consider the kinds of client OSs supported.

Under **scalability**, we consider whether the product offers a true multitasking 32-bit server that you could upgrade to without changing the software on the client. We also assess whether the server works with any third-party server-based utilities for tape backup and virus scan.

SUITABILITY TO TASK

Company name

File sharing	Poor
Printer sharing	Fair
Installation and management	Good
Scalability	Good
Interoperability	Excellent

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easy-to-use interface, interoperability with other networks, and scalability options.

THE UNIVERSAL CLIENT

The major trend today is toward having each end-user system behave as a universal client. Basically, a universal client carries multiple protocol stacks so that it can accommodate being a client to a server under any NOS. Artisoft and Performance Technology have perfected the trick in LANtastic and PowerLan. IBM and Microsoft will follow with the comprehensive capabilities built-in to OS/2 Warp Connect and Windows 95.

People using these client programs get the power to connect seamlessly to servers using practically any popular NOS (except Banyan Systems' VINES). For example, using LANtastic, WfWG, or PowerLan servers for file and print activities does not lock you out of using sophisticated client/server engines or communications links running on specialized servers under other NOSs. Indeed, the universal-client capabilities of these products add flexibility when you use them in a mixed-server environment.

Small-business networks are also strong tools for maintenance and management. Many administrators have learned the pleasure of using LANtastic or PowerLan instead of the limited NetWare client software to back up all their networked nodes to a central server. Trying to install new applications, but short on CD-ROM drives? Use one of these products to share CD-ROM drives and floppy disk drives across the workgroup.

These products are a good value. While they carry about the same \$100-per-node price that you'll pay for the high-end NOSs, you'll get more workgroup features. For example, LANtastic and WfWG each includes a network e-mail and schedule utility, as well as a network fax gateway. PowerLan offers an optional e-mail utility, but no network scheduling or fax.

SCALING BARRIERS

All three products in this roundup are 16-bit applications that run on top of DOS. Because they are applications and not true OSs, their file-server functions have limited capacity and performance. But when and if

SUMMARY OF FEATURES

Small-Business Networks



■ YES ■ NO

Products listed in alphabetical order

	LANtastic Network Operating System v6.0	Microsoft Windows for Workgroups 3.11	PowerLan 3.1
List price (five nodes)	\$499	\$1,095*	\$395
Maximum number of nodes supported	Unlimited	Unlimited	Unlimited
10Base-T/10Base2 support	■ ■	■ ■	■ ■
NDIS/ODI support	■ ■	■ ■	■ ■
Ethernet/Token-Ring support	■ ■	■ ■	■ ■
RAM requirements: client only, server only, client and server	27K, 53K, 53K	4K, 4K, 4K	15K, 20K, 35K
Can load in expanded/extended memory	■	■	■
Program interface	DOS, Windows	Windows	DOS, Windows
Remote access	■	■	■
Built-in NetWare client drivers	■	■	■
Windows-based network-client software included	■	■	■
32-bit dedicated server	LANtastic Dedicated Server	Microsoft Windows NT	Powerserve
File-sharing features			
User can share multiple hard disks	■	■	■
User can execute applications on remote volumes	■	■	■
Disk cache included with software	■	■	■
Printer-sharing features			
User can display print queue	■	■	■
Manager can display print queue and delete jobs	■	■	■
Number of shared printers on a single computer	7	7	5
Centralized management program available	■	■	■
Management interface	DOS, Windows	Windows	DOS, Windows
Administrator can			
Configure groups of users for security	■	■	■
Hide individual files/directories	■ ■	■	■ ■
Password-protect specific resources	■	■	■
Assign file-protection rights	■	■	■
Technical-support number	520-670-7000	206-637-7098	210-979-2010
Telephone support hours (eastern time)	10:00-8:00 M-F	9:00-9:00 M-F	10:00-6:00 M-F
BBS	520-884-8648	206-936-6735	210-979-2012

* An upgrade from Windows 3.1 costs \$349.95 for five nodes

you're about to overload any one of these NOSs, you don't have to throw it away and purchase a third-party high-end NOS.

Each of these three vendors—and several other vendors of products in this class, including Invisible Software (800-982-2962), which makes InvisibleLAN—offers a 32-bit server product that will help you increase the performance and capacity of your small-business network. Artisoft and Performance Technology also offer a host of optional products for network management, tape backup, and remote access.

All three NOSs include multiple network protocols and client drivers. And in addition to connecting to other native servers, they include drivers for NetWare as well. LANtastic and PowerLan each includes the

NCP and SMB redirectors that you can use to connect to NetWare and Windows-based file servers. And, because they connect to IPX and NetBIOS networks, you can add powerful third-party database servers and communications servers to your network when you need them.

The line between small-business networks and high-end NOSs is growing blurrier every day. You can no longer use the number of PCs on your network as the deciding factor when you purchase your NOS. You must look at the type of applications you are using and the network features, such as e-mail and scheduling, that your users need. You might even decide to take advantage of the interoperability built-in to these small-business networks and use multiple products to establish integrated workgroups spread across your network.

Our Contributor: STEVE RIGNEY is a contributing editor of *PC Magazine* and an independent network consultant in Destin, Florida.

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Artisoft Inc.

LANTastic Network Operating System



Artisoft's LANTastic is not only the most popular and one of the fastest small-business networks, it also includes more workgroup features and functionality than any other NOS. In addition to standard file and print services, LANTastic delivers

network e-mail and scheduling, network management, network fax, file-level security, client software for NetWare and Windows-based networks, network DDE, and an interface for both DOS and Windows. The \$119-per-node retail price seems high, but you'll find some aggressive street pricing.

You can install LANTastic Network Operating System v6.0 from either DOS or Windows, selecting features—such as NetWare client drivers, and e-mail and schedule utilities—as you go. The installation takes longer than PowerLan's but

is much faster than WfWG's. Once you've installed it, you can choose from different icons to connect to network resources, manage users and security, and send and receive e-mail and schedule information.

You can connect to network resources with only three clicks of the mouse: Simply select the server's name, the resource name, and the local drive or printer port you want to redirect. The Exchange e-mail and scheduling utilities are great, but they require a lot of system resources and can take a few minutes to launch. While the schedule utility is first-rate, the e-mail program is somewhat confusing. You'll want to have the manual handy.

Like PowerLan, LANTastic includes the NCP and SMB network protocols, which you can use to connect to any NetWare and Windows-based file server. When you load the network drivers, the client software automatically searches for an NCP or SMB server. If it finds such a

server it loads the drivers, but it skips the process if it doesn't, thus avoiding the use of unnecessary conventional memory.

LANTastic doesn't provide the same flexible network printing as PowerLan's

SUITABILITY TO TASK

LANTastic Networking Operating System

File sharing	Excellent
Printer sharing	Good
Installation and management	Good
Scalability	Good
Interoperability	Excellent

THE SIZE OF THINGS

Through 1994, according to International Data Corp. (IDC), in the United States, 35 percent of all PCs and 75 percent of corporate PCs (of a total 76 million PCs) were connected to LANs. According to the vendors, the products reviewed here have achieved the following worldwide sales:

2.7 million LANTastic nodes	750 thousand PowerLan nodes
---	---

(Microsoft does not separate Windows for Workgroups numbers from those for Windows 3.1.) A dozen or so other small-network vendors account for even more connected nodes.

great class printing, but it does provide some neat enhancements. For example, you can configure all of your network print jobs to queue to any network PC. This allows you to place a printer on any file server, but to queue the jobs to a PC with adequate disk space.

Artisoft's excellent security lets you protect all of your resources down to the file level. You can also set up individual access rights, such as write, create, and modify, for each subdirectory or file on your LANTastic servers.

LANTastic provides excellent performance for a DOS-based network, and if you outgrow your LANTastic network, you can always upgrade to Artisoft's 32-bit LANTastic Dedicated Server. Artisoft also offers a host of other products that will allow you to stay with the LANTastic brand name for remote access, communications, and other added network functions.

LANTastic Network Operating System v6.0. List price: For 1 node, \$119; for 5 nodes, \$499. Artisoft Inc., 2202 N. Forbes Blvd., Tucson, AZ 85745; 800-233-5564; fax, 602-670-7101; Web, <http://www.artisoft.com>.

Circle 951 on reader service card

Microsoft Corp.

Microsoft Windows for Workgroups

Even if you take away the built-in peer network and other workgroup utilities, including e-mail and scheduling, Microsoft Windows for Workgroups 3.11 (WfWG) is still a better Windows than Windows 3.1. WfWG offers excellent performance, 32-bit file and disk access, and the ability to run multiple protocol stacks—but only if you run Windows on your network PCs. (Users with DOS

BENCHMARK TESTS

Small-Business Networks



All three small-business networks reviewed here delivered excellent performance on several file-transfer tests we ran at PC Labs, West Coast. Because performance was good across the board, it was not a critical differentiator for designating our Editors' Choice.

Performance Wrap-Up

Here's a quick summary of the testing and results. We ran a testing script that was basically the same as the one we used for our last major roundup of this market ("Peer Pressure," April 26, 1994) with a few changes and exceptions.

This year, instead of running each test on a single client, we ran each with two clients. We also changed our Read with Disk-Intensive Foreground Traffic test by launching the file copy on the server from a client. This simulates database activity on the server and also throws traffic onto the network.

Although each package performed admirably, Microsoft Windows for Workgroups had the fastest times overall. It was especially impressive against LANTastic Network Operating System and PowerLan on the Read with CPU-Intensive Foreground Traffic and Read with Disk-Intensive Foreground Traffic tests. LANTastic was the best (and turned in especially good times) on the Write with No Foreground Task test, both with caching and without.

Partly because we were using faster systems in our test-bed this time (a Pentium/90-based server and several 486-based clients), we saw better overall performance than in the last roundup.—SR



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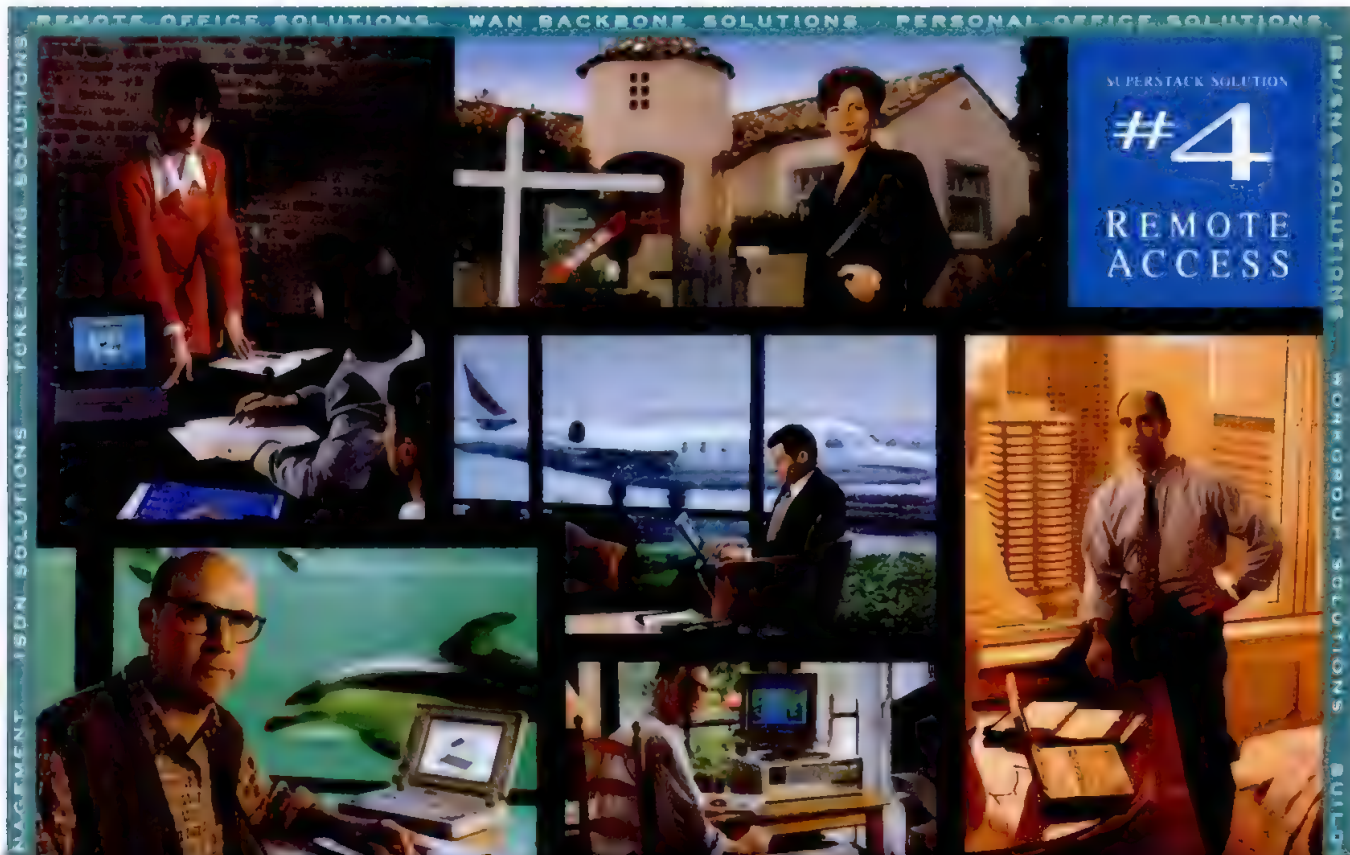
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- ▲ ARCHITECTURE: COOPERATIVE VXD/DLL FOR PERFORMANCE AND RELIABILITY.
- ▲ NETWORK MANAGEMENT FEATURES: SNMP MIB II, EVENT LOG WITH FILTERS, NETWORK STATISTICS WITH VIEWER, AND CONFIGURATION AT A GLANCE.
- ▲ TERMINAL FEATURES: VT320 (TELNET) WITH COMMAND LANGUAGE AND SCRIPT RECORDER, KEYBOARD MAPPING, AND INTERNATIONAL CHARACTER SETS.
- ▲ APPLICATIONS: FTP CLIENT WITH DRAG-AND-DROP FILE TRANSFER, FTP SERVER WITH EXTENSIVE SECURITY OPTIONS, LPR/LPD, AND GRAPHICAL PING AND FINGER.
- ▲ OPEN CONNECTIVITY: 100% WINSOCKET COMPLIANCE PROVIDING ACCESS TO FREeware/SHAREWARE INTERNET APPLICATIONS, AND COMPLEMENTARY WRQ APPLICATIONS.
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REMOTE ACCESS

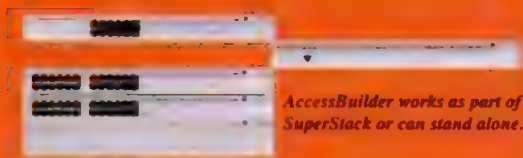
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NETWORK EDITION

COVER STORY

clients should consider one of the other two products.) WfWG retails for a hefty \$219 per node, but most users can upgrade from Windows 3.1 for \$69.95. In addition, Microsoft is positioning Windows 95 as a replacement for WfWG but will sell both for a limited time.

WfWG requires 20 to 30 minutes to install on most PCs. If you've ever installed Windows, you'll find the procedure straightforward. But you will need to know the type of network adapter you're using and your workgroup or Windows NT domain name. A novice user would do better with one of the other products here.

If you're looking for tight Windows integration, WfWG is by far the best of the three. But the network features may seem too integrated with Windows for some users. For example, to connect to a network resource, you must start File Manager, choose the Disk menu, choose the Connect submenu, choose the Browse button, then finally you'll see a list of available servers.

WfWG bundles both IPX and NetBEUI, and you can use either to connect to all of your Windows-based servers. You can also

load the NetWare client drivers if you want to connect simultaneously to Windows and NetWare servers. To add performance and capacity to your network, you can follow the excellent upgrade path to high-end Microsoft Windows NT Workstation and

Server platforms. Windows 95, in addition to the added benefit of 32-bit performance, includes even more networking features than WfWG, (see "Hooked and Linked," May 16, 1995).

Unlike LANtastic and PowerLan, WfWG does not provide alternate print-job queues or class printing, but it does allow you to share and connect

to any printer connected to a WfWG server. WfWG also lacks the file-level security and user management that you get with products like LANtastic.

WfWG is the only one of the three packages to offer built-in remote access. You can use the WfWG Remote Access Services (RAS) client to establish a remote-node connection to a Windows NT RAS server or a PC running WfWG. Some third-party products, such as the Shiva NetModem/E, are specifically designed to work with WfWG networks.

SUITABILITY TO TASK

Microsoft Windows for Workgroups

File sharing	Fair
Printer sharing	Fair
Installation and management	Fair
Scalability	Good
Interoperability	Good

Evolution of NOSs

Network operating systems have evolved from monolith packages in three different directions.

Monolithic network operating systems

Universal client packages, often integrated with small-business NOSs

Enterprise server-based operating systems with extended naming schemes

Small-business NOSs with growth potential

WfWG is a leader in this market, and its Microsoft Mail and Schedule+ utilities are first-rate. But you might choose to wait for Windows 95.

Microsoft Windows for Workgroups 3.11. List price: \$219 per node; upgrade from Windows 3.1, \$69.95 per node. Microsoft Corp., One Microsoft Way, Redmond, WA 98052; 800-426-9400; fax, 206-635-6100; Web, <http://www.microsoft.com>. Circle 952 on reader service card

The Future Is Here (Soon)

Most network administrators would agree that all three products in our roundup provide excellent performance, scalability, and network features. But smart network administrators are always planning for the future. So what's it look like in this market? Well, developers at Artisoft and Microsoft are working on small-business network solutions that provide even better performance, scalability, and network functionality than any product here. Performance Technology is going in some exciting new directions of its own.

Microsoft Windows 95 is the most compelling new solution. Windows 95 is not just a small-business LAN, but an entire desktop operating system. It includes all the network features of Microsoft Windows for Workgroups plus several new features, including 32-bit performance, enhanced remote access, file and print services for NetWare clients, network management, and the ability to load as many as ten network protocols on a single PC.

The developers at Artisoft are working on two new products that should make LANtastic users happy: the LAN-

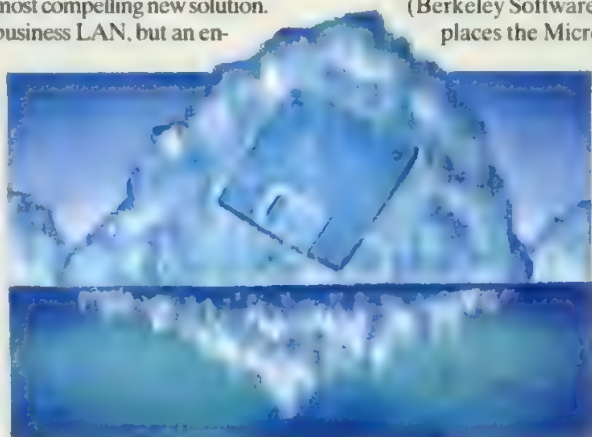
tastic Power Suite and LANtastic for Windows 95. The LANtastic Power Suite should ship by the time you read this. It adds fax and modem sharing, file synchronization, network client caching, a TCP/IP stack, and a host of utilities for accessing the Internet. The Power Suite also replaces the Artisoft Exchange e-mail and scheduling with two products from Lotus Corp.: cc:Mail and Lotus Organizer.

LANtastic for Windows 95 will work with all of Microsoft's networking features and includes the AppleTalk and NFS network protocols. This package also provides a faster BSD (Berkeley Software Distribution) file system that replaces the Microsoft FAT (file allocation table).

Once LANtastic for Windows 95 is shipping, you'll be able to connect to LANtastic-, Macintosh-, NetWare-, Unix-, and Windows-based servers from a single PC.

Performance Technology is not currently working on a new NOS, but the company has released Instant Internet. This package lets you connect to the Internet or other TCP/IP-based networks without loading the TCP/IP stack on your client PC.

—SR



NETWORK EDITION

COVER STORY

Performance Technology

PowerLan

The Editors' Choice in our last major roundup of this market, PowerLan 3.1, provides all the features and performance most small-business networks need. It includes a well-designed Windows interface, flexible network printing, interoperability with NetWare and Windows-based networks, and powerful user and group management. As your network grows, you can add the 32-bit Powerserve dedicated server for perfor-

mance that rivals server-based products. PowerLan retails for \$99 per node (or less in user packs, such as the \$645 Powerbundle, which includes a five-user license, Powerserve, and DaVinci's e-mail software).

PowerLan offers the easiest installation and user interface of the three. When you install PowerLan, all you need to know is the type of network adapter you have; whether you want to be a dedicated server, nondedicated server, or client; and your user name. In contrast, WfWG requires you to update your entire version of Win-

dows and select the type of network protocol you want to use. The LANtastic installation is easier than WfWG's, but it still requires more input from the installer.

PowerLan's Windows-based interface is not only intuitive, but fun to use. If you need to connect to a network resource such as a shared disk drive or printer, you simply drag a power cord icon representing your local port or drive letter and plug it into a wall outlet icon representing the network resource. When you select a resource, it "raises its hand" with a human-hand shaped icon.

Performance Technology offers a separate system called Instant Internet, which works with PowerLan to provide users with Internet access. This \$3,495 plug-and-play device gives 50 users simultaneous full Internet service, including Web browsing, while locking intruders out of the LAN. Instant Internet is also available for NetWare, but not for LANtastic or WfWG.

PowerLan is the only small-business network that provides class printing. With class printing, you can group printers according to particular criteria, such as PostScript support or a specific paper type, size, or color. When you want to print, you designate a printer in a particular class and PowerLan automatically sends your job to an available printer with those capabilities.

PowerLan's universal log-on lets you connect to multiple file servers and resources with a single user name and password. PowerLan distributes the user database to all servers, so if your primary server goes down, you won't lose user information. PowerLan allows you to password-protect individual network resources, but unlike LANtastic it doesn't provide file-level security.

The PowerLan interface and class-printing features are first-rate, and the 32-bit Powerserve is a great lifesaver if you outgrow your network. In this roundup, however, LANtastic simply edges PowerLan out in a few important areas.

PowerLan 3.1. List price: \$99 per node; for 5 nodes, \$395; for 5 nodes and Powerserve, \$645. Performance Technology, 800 Lincoln Center, 7800 IH-10 West, San Antonio, TX 78230; 800-443-5267; fax, 210-979-2002; Web, <http://www.perftech.com>.

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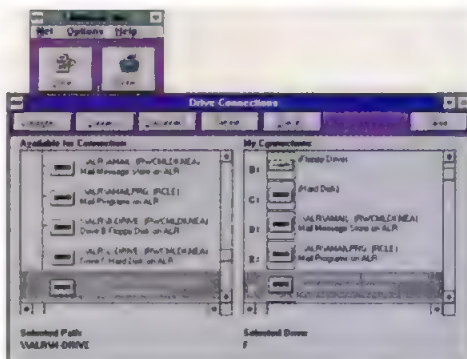
SUITABILITY TO TASK

PowerLan

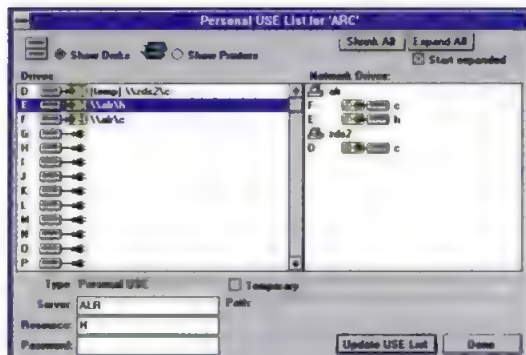
File sharing	Good
Printer sharing	Excellent
Installation and management	Good
Scalability	Fair
Interoperability	Excellent

SMALL NETWORKS, BIG INTERFACES

The LANtastic Network Operating System interface makes good use of Windows icons. You can connect to a network resource with only three clicks of the mouse.



With PowerLan, to connect to a network resource, you simply drag a power-cord icon that represents your local port or drive letter to a wall-outlet icon that represents the network resource.



Although it is tightly integrated with Windows, the Microsoft Windows for Workgroups interface is not the easiest to use of the three.



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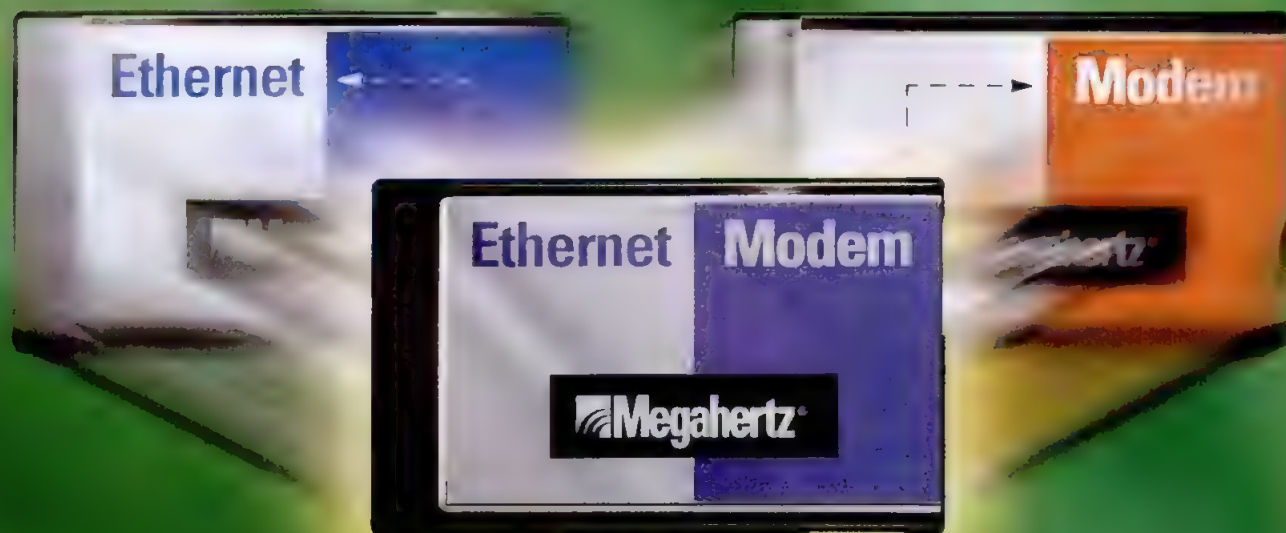


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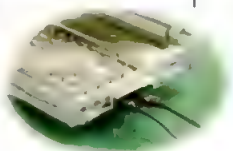
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First Looks

HANDS-ON REVIEWS OF NEW SHIPPING PRODUCTS

OPERATING SYSTEMS

Unix for the NetWare Masses

By John Garris

With UnixWare 2.0, Novell has a real winner. Designed to complement the basic networking services provided with NetWare, UnixWare 2.0 gives customers a reliable, scalable server platform to handle line-of-business applications. The new release adds support for multiple processors, simplified installation, and a graphical management interface, along with improved NetWare interoperability.

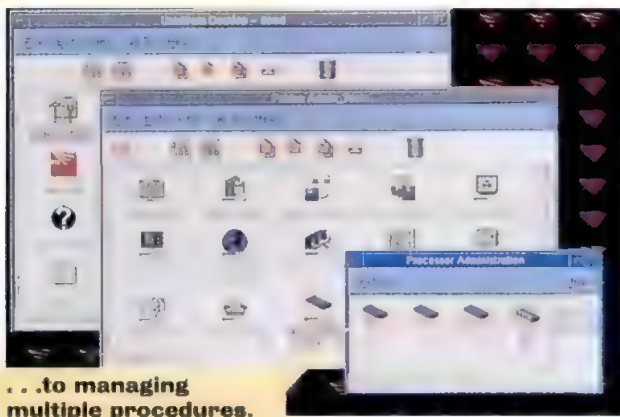
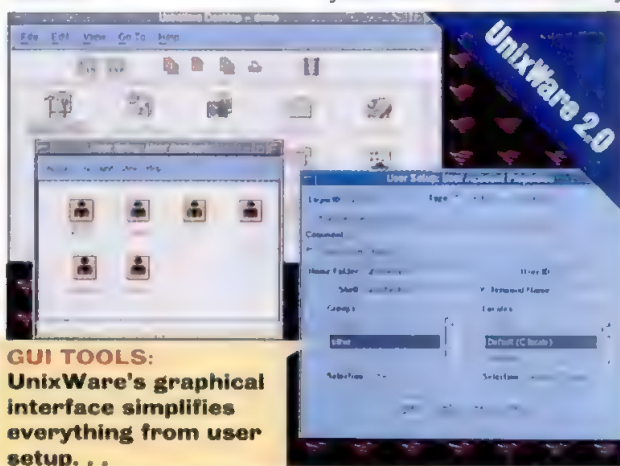
UnixWare 2.0 is a System V Release 4.2-compliant version of Unix that runs on Intel-based computers. UnixWare comes in two flavors: the Personal Edition (\$445), which supports two concurrent users and works with up to two processors; and the Application Server (\$1,695), which comes with an unlimited user license and can scale to twelve processors.

Overall, UnixWare is a serious application-server platform especially suited for NetWare shops. If you want the power of Unix but can't afford to invest in an established RISC-based system, UnixWare may be the choice for you.

EASY INSTALLATION

If you think all Unix-based systems are hard to install and configure, think again. We were prepared for a few headaches simply because of the complexity of the operating system, but we were surprised at how easy it was to get UnixWare up and running. The whole process took just over an hour. Furthermore,

Novell has done the best job to date of any Unix vendor of making its software approachable to Unix novices. All of the configuration utilities are accessible through graphical front ends, and the documentation is easily readable by Unix and NetWare administrators alike. Of course, if you are intimately familiar with Unix you can use the command-line utilities, which are also well documented.



We installed UnixWare on two systems without any problems at all: an HP NetServer 5/66 LF with 128MB of RAM, and a Compaq DeskPro 486/33 with 32MB of RAM. We had trouble installing the product on an HP Vectra XU 5/90 (each time we tried, the system crashed roughly one minute into the installation), but we solved the problem by upgrading the PC's BIOS.

Before you make your purchase, however, you can help minimize the chances of hardware incompatibilities by checking to make sure that your hardware is certified by

Novell to work with UnixWare. The good news is that UnixWare supports a long list of hardware devices, especially when it comes to network adapters: Any adapter driver that is written to the Novell ODI specification can be recompiled to work with UnixWare.

UnixWare 1.1 lacked multi-processor support, but Novell has remedied that in UnixWare 2.0. The new kernel is multi-threaded and preemptive, so well-written applications can take advantage of the extra performance possible in multi-processor systems. Also, UnixWare is compliant with the Intel MP specification 1.1 and is certified to work with AST Manhattan, Compaq ProLiant, and Tricord systems, among others. The UnixWare Application Server lets you use two processors at no additional charge; each additional processor costs \$895.

PLUGS INTO NETWARE

NetWare administrators will appreciate the interoperability between UnixWare and NetWare servers. For one thing, you can map NetWare volumes using the UnixWare file system. UnixWare provides a NetWare Loadable Module (NLM), called NetWare Unix client (or NUC.NLM), which loads on NetWare file servers to give UnixWare users and applications direct access to NetWare files. Unfortunately, this release of UnixWare doesn't work with NetWare Directory Services (NDS).

One of Novell's long-term plans for UnixWare is to let DOS and Windows users log on to a single server for all of their file, print, and application services. Although Novell has

First Looks

outlined its plans to provide NetWare file and print services over UnixWare, no firm details were available on such a product at the time of this review. For now, DOS and Windows clients can only log-on to UnixWare servers using the product's bundled terminal-emulation programs, which run over the NetWare client protocol stack.

NOT JUST UNIX

If you simply can't bear the idea of life without DOS, you can use UnixWare's Merge feature, which lets you run your DOS and Windows applications in an X Window. Unfortunately, Merge only runs Windows in Standard Mode, so none of the popular Enhanced Mode applications, such as Lotus Notes or Novell's WordPerfect, will work with UnixWare.

For existing Santa Cruz Operation (SCO) Unix shops, UnixWare's SCO compatibility mode lets you run existing SCO Unix applications on UnixWare. The product also includes Motif v1.2.3 graphical programming libraries, as well as the Windowing Korn Shell (wksh), an extension of the Korn Shell (ksh) interface, which lets you create graphical applications using shell scripts. Although UnixWare includes a C compiler, Novell sells a separate UnixWare Software Development Kit for \$145, containing C/C++ compilers, a debugger and other development tools.

UnixWare 2.0. List price: Personal Edition, \$445; upgrade from Version 1.1, \$199 (\$99 if Version 1.1 was purchased after November 1, 1994); Application Server, \$1,695; for each additional CPU, \$895; upgrade from Version 1.1, \$395 (\$99 if Version 1.1 was purchased after November 1, 1994). Novell Inc., Unix Systems Group; 122 East 1700 South, Provo, UT 84606; 800-638-9273.

Circle 961 on reader service card

NetWare or UnixWare: Which One?

Novell is actively pushing UnixWare 2.0 as its recommended platform for developing client-server applications. So where does that leave NetWare 4.1 and the upcoming NetWare 4.1 SMP, due out this summer?

NetWare has always been a network services platform, and that isn't going to change. For your file, print, and messaging services needs, you should continue to look to NetWare. Furthermore, smaller shops with in-house NetWare expertise may use NetWare as a database server, to service requests from client applications that were created with popular development tools such as

Microsoft Visual Basic or Powersoft's PowerBuilder. Since many database platforms run over NetWare, this option will continue to be attractive.

Those who need more scalable development environments, however, should look to UnixWare. Specifically, once you plan to move parts of your application code away from your clients and onto the server, you'll want the scalability and reliability of a Unix-based OS like UnixWare to handle your applications. Keep in mind that other OSs, such as Microsoft Windows NT Server, SCO Unix, and SunSoft Solaris x86 compete in the same arena. □

FAULT TOLERANCE

StandbyServer 32: Ready to Serve

By Tony Pomplii

Many network administrators want the security of a ready-to-use, hot-spare server but are ambivalent about Novell's powerful but expensive SFT III. Luckily, Vinca Corp.'s StandbyServer 32 provides a reliable and cost-effective alternative for getting your users up and running in the event of a server failure.

StandbyServer 32 (\$2,599 for ISA, \$2,999 for EISA and Micro Channel) uses NetWare's disk-mirroring feature to duplicate your server's data on a second machine via a high-speed link. If a server crashes, you can migrate server operations to the secondary PC and reconnect your users in just a few minutes.

Unlike in SFT III, the secondary PC does not have to be identical to the primary server. The disk sizes should be similar, and the bus types must be the same, but the disks can be different models and can use disparate interfaces. This product highlight is accompanied by other improvements: Now the software is a 32-bit NLM rather than a DOS TSR, the StandbyServer 32 adapters are faster, and a runtime version of NetWare 3.12 is included.

StandbyServer 32 is a simple and cost-effective way to minimize your downtime. Better documentation, diagnostics and notification would be icing on the cake for this useful, face-saving product.

SERVER SETUP

We set up our StandbyServer 32 system on a pair of AT&T Globalyst 486/33 PCs, each equipped with an ISA StandbyServer 32 adapter. The two adapters were connected with a high-speed, 25-foot cable that runs bidirectionally at 80 Mbps under ISA and 160 Mbps under EISA or Micro Channel.

During our installation, we ran into a few minor problems. Most notably, the setup program does not copy the necessary disk or LAN drivers into the DOS standby subdirectory if they are on a separate path; in this case, the AUTOEXEC.NCF and STARTUP.NCF must then be slightly modified for the machine to boot correctly. Also, when we ran into a few interrupt conflicts, the test program, SBCHECK, issued only a single, vague error that fails to pinpoint the culprit.

After we completed the installation, the duplication of

data was fairly simple. When the server pair boots, the NLM initializes the StandbyServer 32 adapters and links them together. The standard NetWare mirroring tools are then used to keep the data on both machines identical. All the while, a simple interface on the backup monitor displays connection status, CPU utilization, and other statistics.

PULLING THE PLUG

We pulled the plug on the main machine to see the StandbyServer 32 in action. Our workstations were immediately notified that the server was down, and we then booted the backup machine manually to bring it up as a regular NetWare server. Since the files had been continuously mirrored, this server retained files updated within seconds of the main server's power loss.

This startup process was flawed only in its dependency on a manual boot-up. As we went to press, however, Vinca introduced an AutoSwitch feature, which senses the loss of the main server and automatically boots the standby machine into NetWare.

StandbyServer 32. List price: ISA, \$2,599; EISA or Micro Channel, \$2,999; Vinca Corp., 1815 S. State St., Orem, UT 84058; 800-934-9530; fax, 801-223-3107.

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COMMUNICATION SERVERS

Cubix Builds on Its Base

By O. Ryan Tabibian

Essentially, the new Cubix ERS/FT II is more of a good thing. Building on an already solid hardware platform, Cubix Corp. has added 60-MHz Pentium processor boards and—most important—a Windows-based management utility.

Put these features together and you'll be hard-pressed to find a more comprehensive solution than the Cubix ERS/FT II. You should note, though, that while the ERS/FT II is rather affordable for a communication server, its total price can climb in a hurry as you add processor boards.

Like the J&L ChatterBox (also reviewed here), the ERS/FT II has a large enclosure that houses multiple CPU motherboards. Typically, communication servers like the ERS/FT II are used for remote-access applications, but you could use them for any task a standalone server would perform. What differentiates these boxes from other systems is fault tolerance and management.

Cubix certainly has the bases covered with regard to fault tolerance. The ERS/FT II comes with redundant power supplies and fans, as well as individual control over the power to each board in the



NEAT AND TIDY: The ERS/FT II's components are easily accessible for maintenance or upgrades.

slot (rather than to each bank of slots as was the case previously) and auto-sensing of devices in the enclosure.

Cubix also now offers processor boards based on the 66-MHz Pentium CPU. Our test configuration, which cost approximately

server. Everything from processor boards to power supplies is hot-swappable. As with the J&L product, you can also manage all the processor cards through a single keyboard and monitor.

New features include the ability to control power to each

\$19,000, included four processor boards: one 60-MHz Pentium, one 100-MHz 486DX4, one 66-MHz 486DX2, and a dual-processor 50-MHz 486DX2 board. J&L, on the other hand, now offers both 90-MHz and 100-MHz Pentium processor cards on the ChatterBox.

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First Looks

NEW-LOOK MANAGEMENT

But the biggest improvement to the ERS/FT II is the new management software. The original ERS/FT included BC-Vision, a DOS-based utility that allowed you to monitor the status of the server and the backplane as well as the temperature of the unit.

BC-Vision was not only limited in scope but was difficult to use. The new management software changes all that. The Windows-based Cubix Management System (CMS) gathers information and reports on all aspects of the server. CMS maintains most of BC-Vision's features, but adds a GUI and some extra features, such as the ability to manage multiple enclosures from a single location. CMS also plugs into the Novell Management System (NMS) 2.0.

With CMS an administrator can also remotely control the flow of power to each slot on the ERS/FT II, regardless of where the server is located on the network. This is particularly helpful for managing remote offices. With CMS a network manager can also set thresholds on different functions of the server, such as excessive temperature, and receive a notification if those thresholds are exceeded. Unlike J&L's ChatView software, CMS does not provide pager support for these notifications.

Cubix ERS/FT II. List price: tested configuration, \$18,966. Cubix Corp., 2800 Lockheed Way, Carson City, NV 89706; 702-883-7611; fax, 702-882-2407.

Circle 963 on reader service card

COMMUNICATION SERVERS

J&L's Server Room in a Box

By Steve Rigney

Most large networks contain dozens of servers to handle dozens of tasks, including remote access, file and printer sharing, fax, and e-mail. But the cost of multiple servers and the space they require can stress your budget and your building.

Enter the J&L ChatterBox, which can bring all of your server applications into a single enclosure. With strong management software and a wide array of powerful processor cards, the ChatterBox is a major force in the communication-server market. As with the Cubix ERS/FT II (also reviewed here), though,

the price on the ChatterBox can jump up in a hurry. Our test configuration, for example, cost over \$33,000. Still, that's probably going to be more economical than buying a comparable group of standalone servers.

The ChatterBox looks like a miniature refrigerator, while the ERS/FT II looks like a big PC chassis. The ChatterBox holds up to ten 486 or five Pentium cards. Each card is hot-swappable, and you can manage all of them remotely using J&L's ChatView SNMP-management console.

J&L Information Systems is the first vendor to offer a Pen- II (Continues on page NE21)

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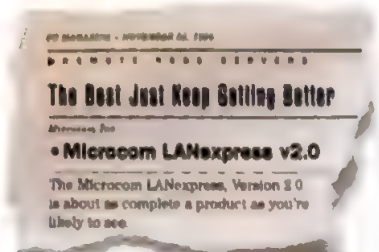
Management view



User view



Review



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CIRCLE 893 ON READER SERVICE CARD

J&L

Continued from page NE19
tium/100 processor in a rack-mounted server, but it's expensive. The Pentium/100 card (with 8MB of RAM) costs \$5,140. We couldn't get a Pentium/100 board in time for this review, but the configuration we tested was pretty impressive: two Pentium/90s, one 486DX2/66, one 486DX4/75, one 486DX4/100, and one 486SX/25.

Both the ChatterBox and the ERS/FT II let you control all of your processors with a single keyboard and monitor. Unfortunately, we had to go through two monitors and nine keyboards before we found one of each that worked with the ChatterBox's multiplexer. We also did not like the location of the shared video and keyboard ports. They're at the back of the chassis and point

straight down. Unless you remove the back panel, it's hard to reach these ports. Also, the ChatterBox does not include a second power supply. You can purchase one from J&L, but it costs another \$3,695.

Both the ChatterBox and the ERS/FT II include hot-swappable processor modules. If you want to replace a failed processor on the ERS/FT II, however, you must flip a switch before you remove the card. You don't have to do this on the ChatterBox; while not a major advantage, this does eliminate one easy way to destroy a processor card.

MANAGEMENT, PLEASE

One of the most appealing ChatterBox features is the ChatView SNMP-management software. Like the Cubix Management System (CMS), Chat-

View is a Windows-based program you can use to control all the processors from a remote location. ChatView lets you gather user and system information and reset hung processors. ChatView works with any Windows-based SNMP-management platform.

Unlike CMS, which lets you gather information on hardware components, including the CPU, RAM, and hard disk of each processor board, ChatView is limited to data such as the name of the user connected to the processor and the number of processors in a rack. ChatView does support pager notification of alerts, however, while CMS does not. **J&L ChatterBox.** List price: tested configuration, \$33,263.



BIG BOX OF SERVERS: The ChatterBox can hold up to ten processor boards.

J&L Information Systems, 9600 Topango Canyon Blvd., Chatsworth, CA 91311; 818-709-1778; fax, 818-718-1237.

Circle 964 on reader service card

THE NETWORKER By Diane Danielle

CD-ROMs: Time to Go?



In my last column, I mentioned several reference tools available on CD-ROM. What I didn't say was how much I dislike the technology.

For distribution, CD-ROMs have an advantage over floppy disks. If the install program is well designed, installation is faster and requires less hand-holding. As

a medium, the CD-ROM's claim to fame appears to rest on capacity: 600MB of data on a small disk! But not all of these disks actually contain 600MB of anything. That wouldn't matter if it were not for the proliferation of CD-ROMs.

For the individual user with a drive, it's a return to the days of the single-floppy-disk-drive PC. The advantages of hard disk capacity and performance, as well as multitasking and multiprocessing, are lost the moment you want access to two CD-ROMs at the same time.

Networks are the hardest hit. To provide users with easy, concurrent access to CD-ROMs, network managers must negotiate a mine field of issues. CD-ROM changers don't help, because they still can read only one CD at a time. Towers permit simultaneous access to more than one disk, but with limitations. How many drives, for example, can you actually attach to a server? And, if you can solve the multiple-SCSI-card installation problems, do they all need unique drive letters? (With 20 CD-ROMs, you'd have 6 letters left over for your local and net-

work drives.) Multivolume CDs are another problem.

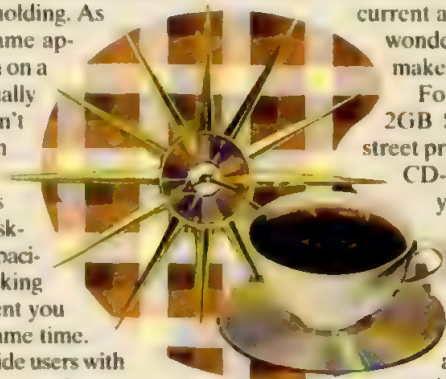
Access control is also a concern. If the drives are attached to the server, do you really want to give your users the freedom to insert and remove the discs? If you choose a dedicated CD-ROM server, you need access-control software that is easy to use but robust enough to prevent somebody from removing a particular CD when it is in use by somebody else. Performance is another important issue that's often brushed aside—but your users will notice it.

What to do? Although various solutions are available, and most are sufficient to handle lower-end requirements (concurrent access to seven or fewer CD-ROMs), I wonder if we even ought to be struggling to make these CDs accessible on our networks.

For a little over \$1,000, you can buy a 2GB SCSI-2 drive, and 9GB drives have street prices under \$4,000. Why not dump your CD-ROMs to one of these drives and give your users the kind of access they deserve? It is, admittedly, an expensive and potentially time-consuming solution if you must support dozens of CD-ROMs.

But I encourage you to calculate the amount of disk space you would actually need for your network CD-ROMs (remember, they don't all contain 600MB of data). Figure the cost of equivalent disk space and weigh that cost against your CD-ROM management issues. Both you and your users may be pleasantly surprised.

Diane Danielle, an independent networking consultant, can be reached on CompuServe at 72241,2566 or MCI Mail at 383-1159.



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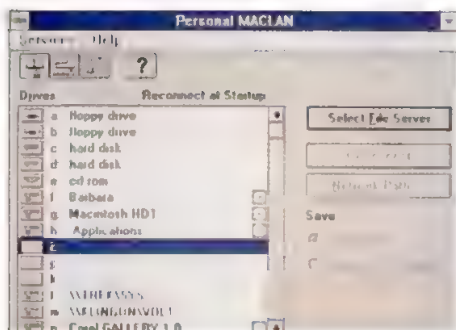
NEWS OF ANNOUNCED PRODUCTS AND UPGRADES

By Leslie Wygant

Mac and PC Users Share with MacLan

It's usually easy to share files and printers between PCs, but what if you're using a PC and you want to share a file with someone working on a Macintosh? **Miramar Systems** offers Personal MacLan Connect Version 5.0, a cross-platform software-based solution for peer-to-peer networks. New to MacLan 5.0 is Windows AppleShare software for full peer-to-peer file and print sharing between Windows PCs and Macintoshes. **Personal MacLan Connect Version 5.0**. List price: \$199 per PC. **Miramar Systems Inc.**, 121 Gray Ave., #200B, Santa Barbara, CA 93101; 800-862-2526.

Circle 955 on reader service card



LET'S SHARE: MacLan Connect 5.0 lets you connect PCs and Macs to share resources.

CDSI Keeps Track of Who's Using What

It's critical to keep on top of who is using which applications on your network. **Central Design Systems** offers LicenseTrack to give network administrators a graphical view of usage patterns and system loads, making it possible for them to track licenses and determine how many licenses are needed. In addition to setting limits on software usage, you can set soft limits and be alerted by e-mail before the license limit has actually been reached.

LicenseTrack. List price: for PC, \$995 and up; for Unix, \$5,000 and up. **Central Design Systems Inc.**, 2346 Bering Dr., San Jose, CA 95131; 800-366-2374.

Circle 956 on reader service card

HOT PROSPECT

IBM Roams Around Near and Far

Wireless technology gives you the freedom to move around, untethered by physical connections to your network. **IBM** has embraced the idea of anytime, anywhere wireless access for both near and far locations. Aimed at users such as hospital, and retail personnel, IBM's Wireless LAN Entry offers a complete LAN-roaming solution, consisting of an access point and a PCMCIA adapter. For wide-range users, such as repair technicians and public safety employees, IBM offers wireless laptop PC modems for access to such things as fax and voice mail. Modems for Mobitex (RAM Mobile Data) and ARDIS are both available now, and a wireless modem for Cellular/CDPD networks is scheduled to be available in June.

IBM has also added to its line of network offerings a Token-Ring switch and several ATM products. **Wireless LAN Entry PCMCIA Adapter**. List price: \$445. **Wireless LAN Entry 8227 Access Point with Integrated Antenna**. List price: \$1,350. **Wireless Modem for Mobitex-PCMCIA**. List price: \$795. **Wireless Modem for ARDIS-PCMCIA**. List price: \$995. **Wireless Modem for Cellular/CDPD-PCMCIA**. List price: \$1,095. **IBM Corp.**, Rte. 100, Somers, NY 10589; 800-426-3333. Circle 954 on reader service card



U.S. Robotics Adds V.34 to NETServer

The remote-access market is growing, and fast. **U.S. Robotics** has joined in with the Total Control NETServer family of products for remote access on LANs. New to the family of remote products are Total Control NETServer/8 and Total Control NETServer/16. Both integrate NETServer's network-access engine with V.34, V.Fast Class, and V.32terbo modem technology and include remote-node access, LAN-to-LAN routing, management, and security.

Total Control NETServer/8. List price: \$7,995.

Total Control NETServer/16. List price: \$11,995. **U.S. Robotics Inc.**, 8100 N. McCormick Blvd., Skokie, IL 60076; 800-877-2677.

Circle 957 on reader service card



Fast Remote: U.S. Robotics has integrated V.34, V.Fast Class, and V.32terbo into NETServer.

Bay Networks' Optivity for the Enterprise

You've seen separate management packages for LANs and WANs, but what about a solution for LANs, WANs, and internetworks across an enterprise network? **Bay Networks** has announced Optivity Enterprise 6.0, which includes enterprise-wide troubleshooting, configuration, monitoring, and analysis in three applications (available separately or as a bundled solution).

Optivity Enterprise. List price: \$13,995. **Optivity LAN, Optivity Internetwork, Optivity Design and Analysis**. List price: \$5,995 each. **Bay Networks Inc.**, 8 Federal St., Billerica, MA 01821; 508-670-8888. 4401 Great American Pkwy, Santa Clara, CA 95054; 800-776-6895. Circle 958 on reader service card

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RangeLINK. List price: \$2,975 to \$3,725. **Proxim Inc.**, 295 N. Bernardo Ave., Mountain View, CA 94043; 800-229-1630.

Circle 959 on reader service card

BRIEFS

HARDWARE

Grand Junction Networks has cut prices to \$199 per port—a 22 percent decrease—for its FastSwitch 10 workgroup switch (\$4,975). 800-747-3278.

Amber Wave Systems announces the AmberSwitch workgroup switch (\$1,995 for eight ports), which includes an adaptive cut-through switching scheme for combined cut-through and store-and-forward capabilities. If it detects packet errors, the AmberSwitch automatically moves from cut-through to store-and-forward switching, and then returns to cut-through when it no longer detects errors. 508-266-2900.

Network General Offers a Database with a View

Databases and networks are intrinsically tied together, yet administrators haven't been able to share views. **Network General Corp.** has announced the Database Module for Oracle7 SQL Net, the first in a family of products for monitoring and analyzing database transactions in distributed LAN/WAN client/server environments. The Database Module integrates Network General's Sniffer Network Analyzer (available now) and Distributed Sniffer System (scheduled for June availability) with Oracle's Oracle7 RDMS. **Database Module for Oracle7 SQL Net.** List price: \$1,495 per Sniffer Network Analyzer topology, \$795 per Distributed Sniffer System server (promotional price). **Network General Corp.**, 4200 Bohannon Dr., Menlo Park, CA 94025; 800-764-3337.

Circle 960 on reader service card

MULTIPLE ACCESS By Frank Derfler

The Shape of ATM



Wow, what an issue of *PC Magazine: Networking* meets Zen. Associate editor Gail Shaffer sees the network diagram as a Rorschach test. In the Network Edition we examine NOSs that are clients looking for a host and later in the magazine we talk about mega-hosts looking mainly for mega-peers. If a server connects to a server without a client, is it still a network? What is the sound of one server polling?

Still, you haven't really been raised to a higher consciousness until you've contemplated ATM. I've got some news and some advice for you: Open your mind and embrace ATM. It is whatever you want it to be.

If I might mix metaphors—ATM is like an elephant being described by three people in a dense fog. The engineers at Optical Data Systems (ODS), a nifty company in Richardson, Texas, see the elephant's leg. For them, ATM is like a tree trunk supporting a huge system. Specifically, ODS has installed ATM pipes to link Army posts throughout the U.S. News reports suggest the entire Department of Defense might soon pass imagery, videoconferencing, and big data files over a very robust OC3 ATM WAN. (OC3 means optical carrier level 3, a standard for 155.52-Mbps signaling over fiber.) So, for some enlightened ones (with enlightened budgets), ATM is a big backbone.

The planners at Adaptec Corp. see the elephant's flexible tail. Adaptec is extending its impressive name recognition to

25-Mbps ATM adapters for desktop PCs. Sun Microsystems, always on a higher plane, is providing 155-Mbps adapters for its desktop computers. But many companies, including Adaptec and IBM, think that guaranteed synchronized data delivery across a 25-Mbps channel is enough for upcoming desktop applications.

Clearly 25-Mbps products provide an opportunity to experiment with ATM on a budget. If you have any interest in using ATM to the desktop, plan to start a test setup this fall. You'll need some high-powered client PCs equipped with PCI or EISA bus architectures and about \$1,000 per port for the adapter and hub. The 25-Mbps ATM system operates over good old Category 3 UTP, so cabling isn't an issue.

So far, though, we haven't gotten a good image of the elephant's body or trunk. Practical wiring hubs for 25 and 155 Mbps are lagging behind the adapters (adapters are useless without hubs), and the tariffs for high-speed long-distance connections need work.

Good hubs will appear from the mists this fall. A few standards must solidify before the silicon for the hubs materializes. The tariffs will take much longer. Many people fall under the spell of ATM without realizing that the 155-Mbps leased line used for long-distance connections can cost tens of thousands of dollars a month.

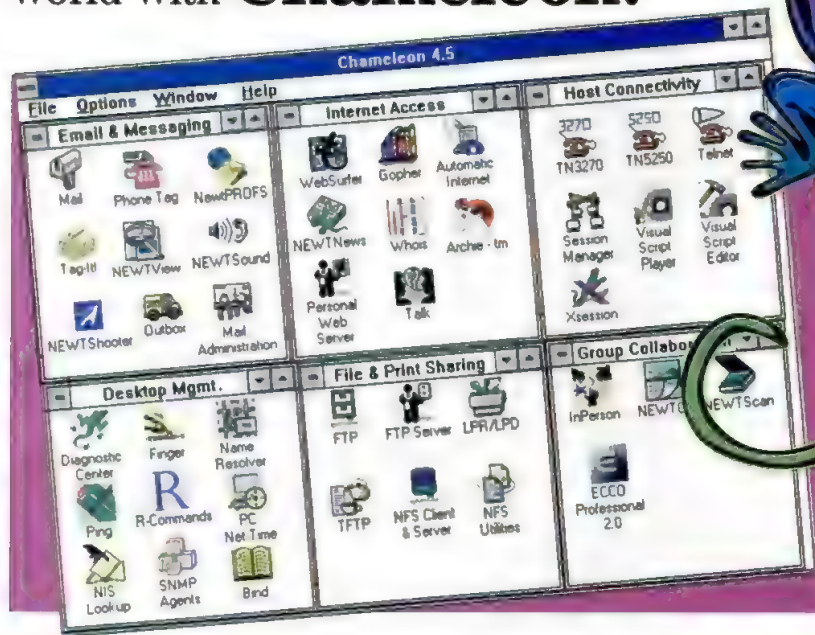
Will the influence of ATM disrupt the cosmic integrity of other systems like 100Base-T or 100VGAnyLAN? You betcha! Fast Ethernet (100Base-T) is so simple and inelegant that it will prosper anywhere, but 100VG could feel more of a hit from ATM.

The Zen of ATM is that it is everywhere and nowhere at the same time, but if you concentrate, it just might appear on your desktop very soon. □



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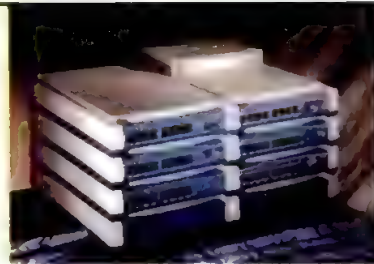
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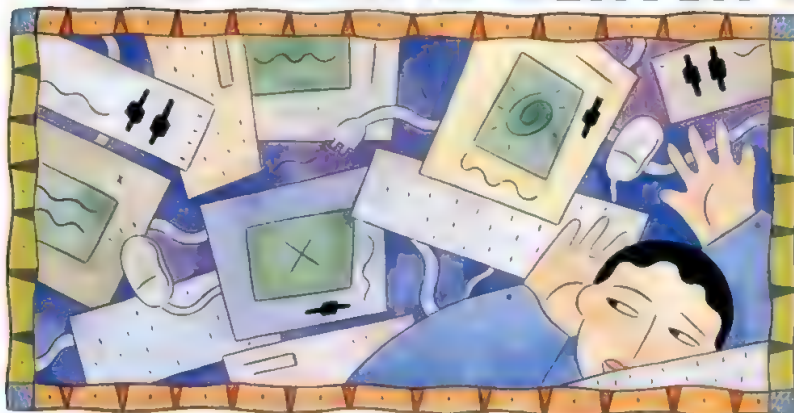


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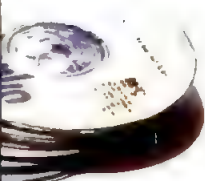
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CIRCLE 304 ON READER SERVICE CARD

TAPPING THE PROMISE OF THE PENTIUM

Powerful 586-class PCs based on the Intel Pentium and the NexGen Nx586 are poised to overtake 486s. But fulfilling the chips' potential means choosing the right components. PC Labs test 100 systems to see which ones stand out.



By John Clyman

Everybody wants one. But until recently, it would have been hard to justify a Pentium system to your boss or the company bean-counter unless you could pass yourself off as a developer, desktop publisher, or CAD jockey. Today, it's a different story: A proliferation of new Pentium vari-



FASTER AND CHEAPER CPUs

Look to the Pentium/120 for breathtaking performance, the Pentium/75 for value, and the Nx586 for rock-bottom pricing.

ants, from the aggressively priced 75-MHz version to the breathtakingly fast 120-MHz model, points to one conclusion. This will be the year that the Pentium displaces the 486 to become the mainstream CPU of choice.

Impossible? As early as the fourth quarter of 1994, Gateway 2000 reported that just over half the PCs going out its doors had Pentium chips inside. Though many of those systems

were sold to home users with appetites for multimedia, business buyers are finally beginning to recognize the Pentium's appeal. Basic configurations are headed for \$1,500, with more fully equipped machines (1GB hard disk, CD-ROM and sound, 15-inch monitor) readily available for \$2,500. And the average Pentium/75 runs real applications at nearly twice the speed of a typical 486DX2/66—a difference not easily overlooked (see the chart "System Performance by Processor Type").

Actually, the Pentium isn't the only alternative to the 486. The NexGen Nx586 is now shipping as well, and although we've found it doesn't keep pace with Intel's latest offerings, it does promise rock-bottom prices for 586-class power; Compaq has even announced plans to use it in the consumer-oriented Presario line. And in the next few months, we expect to see the first machines built around AMD's K5 and Cyrix's M1, both of which claim to outperform the Pentium/100 by about 30 percent.

As the Pentium family matures, a new round of core-logic chip sets and system components is being introduced to help feed the ever-more-hungry beast—and, conversely, to take advantage of ever-more-plentiful processing power. In this roundup we'll take a close look at the state of the art in 586-

SOUND BOARDS AND SPEAKERS

Even buttoned-down business machines will need audio features to support multimedia-enabled applications fully.

class systems today and offer a glimpse at where they're headed tomorrow.

REVIEW CRITERIA

When we invited PC vendors to submit systems based on new Pentium and Nx586 CPUs, the response was staggering: 53 companies sent us a total of 100 machines. We initially allowed vendors to submit two Pentium systems, one based on the 75-MHz CPU introduced in October of 1994 and the other based on the 100-MHz processor that until a few months ago was difficult to find in appreciable volumes. We also tested eight Pentium/120 PCs.

We also asked vendors to send us two Nx586-based machines. Because NexGen's parts aren't available at clock speeds identical to those of the Pentium—the chips' internal architectures are dramatically different, so clock-for-clock comparisons aren't meaningful anyway—we let vendors choose the clock speeds themselves. Seven vendors chose to send NexGen systems. We received units with the 75-MHz Nx586-P80 and the 93-MHz Nx586-P100, which is the fastest version available today. (NexGen's unusual nomenclature is intended to communicate

which Pentium CPU is most comparable to a given Nx586 part; the company claims the 93-MHz Nx586-P100 is a match for the 100-MHz Pentium, for instance.)

Intel announced the Pentium/120 CPU just as we were finishing our testing, so we also acquired and tested a limited set of machines based on the brand-new part. By the time you read this, many more vendors will be offering 120-MHz PCs. But you can be sure the processor, which is fabricated on a new 0.35-micron process (smaller even than the forthcoming 133-MHz P6), will be in tight supply—and expensive—for months to come. 150-MHz Pentiums should be released by year's end.

Finally, we asked a handful of vendors to submit 90-MHz machines to provide a basis for comparison. We received systems from Dell Computer Corp., Hewlett-Packard Co., and Zenith Data Systems—all Editors' Choice selections in our previous roundups of 90-MHz Pentium PCs (September 27, 1994 and December 6, 1994).



NEW CHIP SETS

Intel's Triton chip set supports EDO
DRAM and pipelined-burst cache,
boosting system performance

We also tested 90-MHz Pentiums from Compaq Computer Corp. and IBM Personal Computer Co.

The 60- and 66-MHz Pentiums aren't represented here, nor will you find them on store shelves much longer. These earliest Pentium CPUs run hot, perform no faster than today's top-of-the-line 486-class systems, and cost manufacturers only about \$30 less than 75-MHz Pentiums. Don't be swayed by the fire-sale prices you might see on this obsolete technology.

As for components, we required full multimedia configurations: 16MB of

RAM, CD-ROM drive, sound, and color SVGA monitors. Hard disks had to be 540MB (unformatted) or larger for the midrange 75-MHz systems and 1GB or larger for the 90-, 100-, and 120-MHz PCs.

One participant in this roundup—Hewlett-Packard—maintained that business-oriented PCs don't need sound. We disagree, but we also wanted to include HP's systems (one of which, the 90-MHz Pentium Vectra, is a previous Editors' Choice); thus, some of the company's machines are represented here sans audio capabilities.

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WHO'S MISSING

A handful of major vendors opted out of this review or weren't able to supply machines in time for us to test. Advanced Logic Research declined to participate. AT&T Global Information Solutions (AT&T GIS) was in the midst of revamping its Globalyst line of telephony-enabled desktop systems. Epson America was not shipping machines in time for this roundup. Packard Bell, a retail vendor that focuses heavily on home users, declined. We did review a Packard Bell system in our roundup of home PCs ("What Goes into a Great Home PC," December 20, 1994).

Compaq was also in the midst of a product overhaul as we completed this story. Compaq's Deskpro line is being enhanced with security and asset management features that link into Compaq's server management software, Insight Manager.

Expect to see widespread announcements of support for similar DMI (desktop management interface) capabilities from first-tier vendors, including Dell, IBM, and NEC, in coming months.

VOLATILE PRICING

Because of the sweeping changes under way in the PC market, prices are likely to vary somewhat from those listed here, which were current in late March. In some cases you may see higher prices as spot



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Enhanced IDE with Mode 4 PIO support is the route to unparalleled disk performance.

component shortages take their toll. Certain types of high-speed static RAMs (used for L2 cache) and quad-speed CD-ROM drives in particular have been subject to supply limitations in past months.

As manufacturers strive to hit key price points—particularly in retail channels—you're also likely to see many Pentium/75 systems advertised with only 8MB of RAM. For this review we tested all machines with 16MB of RAM, and we strongly recommend you purchase Pentiums in that configuration: Although it will cost about \$300 more, it will add more than 50 percent to your system's overall performance (see the chart "How RAM Affects Performance").

MEGA MEMORY

In fact, memory is an area where you'll find much of the innovation in this crop of PCs. It's no secret that high-performance CPUs need rapid access to data. That's why all modern processors employ caching and partly why Intel gave the Pentium a 64-bit data bus rather than the 32-bit data bus used by its 486 predecessors.

But as CPU speed has increased, RAM speed has hit the wall: 60-ns parts are the fastest DRAMs available today or on the horizon. So, as CPU speeds continue to climb, memory-access times will become more and more of a bottleneck.

Memory manufacturers have proposed nearly a dozen varieties of memory that offer better performance than the fast-page mode DRAMs that predominate. The only one that's been adopted in shipping systems to date is EDO (extended data out) DRAM, an incrementally altered type of fast-page mode DRAM that keeps data available to the CPU even while the next memory access is being initiated. This overlapping access pattern effectively lets the memory act as if it's much faster than it really is. Right now, EDO DRAM may carry a price premium of about 5 percent, but this differential will vanish shortly as production speeds up. In testing a PC with both standard and EDO DRAM installed, we

HIGHLIGHTS

Pentium and Nx586 PCs

Pentium PCs are charging into the mainstream as Intel unleashes myriad new Pentium implementations. Value-priced Pentium/75 CPUs, available in PCs for as little as \$2,195, are rendering hot-running 60- and 66-MHz Pentiums obsolete. At the opposite end of the spectrum, 120-MHz Pentiums are setting performance records. 100-MHz versions of the chip, freed from supply constraints, are pressuring 90-MHz parts that until recently defined the high end of the market.

THE NEXGEN Nx586 CPU, the first Pentium competitor to ship, promises performance that matches that of the Pentium. But our tests show

that the first round of systems based on the Nx586-P100 CPU, the fastest version available, only reach the level of 75-MHz Pentium PCs. And because NexGen's chip set only supports VL-Bus and ISA today, expansion options are narrower than with PCI-based Pentium systems.

MEMORY IS KEY to making the most of a 586-class CPU. Don't settle for less than 16MB of RAM—you'll take a 30- to 50-percent performance hit with only 8MB. To maximize performance, some manufacturers are using EDO (extended data out) DRAM, a slightly altered form of the traditional DRAM that offers as much as a 5 percent performance boost.

CORE-LOGIC CHIP SETS are advancing. Intel's Triton chip set, appearing in 22 of the systems here, supports EDO DRAM, faster cache SRAM, and an enhanced PCI burst mode. It's less expensive than the Neptune chip set found in most Pentium PCs today; its only major sacrifice is lack of support for multiprocessing.

COMPONENTS and peripherals are getting faster to keep up with speedier CPUs. Quad-speed CD-ROM drives have displaced double-speed drives virtually across the board. New EIDE hard disks support Mode 4 PIO that offers a 16.7-MBps transfer rate versus the 11.1-MBps rate of more common Mode 3 implementations.

Performance-Oriented**Gateway P5-120****Micron P120 Millennia**Mainstream**Austin Power Plus 100****Gateway P5-100XL**Value-Oriented**Austin Power Plus 75**

The Gateway P5-120 is the most exciting machine in this roundup—the kind of system that elicits unabashed wows.

Aside from being one of the fastest PCs we've ever tested, it comes with a stunning array of components, including a 17-inch monitor, 1.5GB Enhanced IDE hard disk, and quad-speed three-CD changer. All this goes for just \$4,299.

The Micron P120 Millennia, at \$3,799, is the least expensive Pentium/120 system here. But it doesn't skimp on critical features: It comes with a 15-inch monitor and 1.2GB Enhanced IDE hard disk, and, in the Micron tradition, it was also a stellar performer.

Among 100-MHz Pentium systems, the \$3,499 Austin Power Plus 100 is one of our favorites. It's the third-fastest 100-MHz machine and is equipped with a

determined that EDO DRAM provides a performance boost of 1 to 5 percent overall.

Fourteen of the units in this roundup employ EDO DRAM. You can't just jack up the performance of any system by dropping in these new SIMMs, though: The machine's core-logic chip set must support the alternative timings that EDO memory requires. Right now, only Intel's Triton chip set—successor to the Neptune chip set found in most Pentium machines today—supports EDO memory. OPTi's new Viper-M chip set, which also supports EDO, will be available in volume in June. In coming months, chip sets from SIS and VLSI will incorporate EDO support as well. Triton was released just as we were acquiring the last products for this story, and only 22 machines here employ it—but we expect most manufacturers to make the switch from Neptune in the next few months.

As memory technology advances,

we're seeing a trend: Vendors are abandoning parity SIMMs. Parity-checking is a primitive technique that lets the machine detect single-bit memory errors by adding a ninth bit to each eight-bit byte of data. Support for parity used to be critical, because transient memory errors were relatively commonplace. A machine couldn't correct them, but it could at least report "PARITY CHECK" and lock up to prevent corrupted data from being saved.

Today, RAM chips are reliable enough that, statistically speaking, you could leave a PC with 16MB of RAM on 24 hours a day for more than ten years and never encounter an error. Apple has used nonpar-

ity SIMMs in its Macintosh family for years, and many PC manufacturers have followed suit (to save about 10 percent in RAM costs). The logic behind the decision: Parity errors are far less common than software bugs or other glitches; if you truly need fault tolerance, as in a high-end application server, buy ECC (error checking and correcting) RAM, which can actually fix single-bit errors.

Looking for a full-featured machine at an eminently reasonable price? The Austin Power Plus 75 (\$2,699) isn't the least expensive system here, but it offers strong performance and features such as a Media Magic Telemetry-32 sound board, which provides wavetable-synthesis audio and 19.2-/14.4-Kbps data/fax modem capabilities (including voice mail).

Except for the Austin Power Plus 75, all of our Editors' Choices use Intel's Triton chip set, which does confer a marginal performance advantage. We expect most other vendors will adopt Triton in the next few months as well.

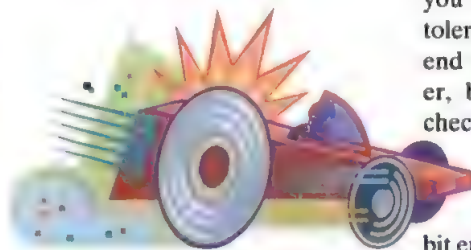
HONORABLE MENTION

We also saw a number of appealing machines that didn't quite earn an Editors' Choice. Among 120-MHz systems, these include the Austin Power Plus 120 (\$4,499) and the Insight PCI P120 MM (\$4,499). A much broader variety of 120-MHz machines will be available as you read this; we'll follow up with a larger roundup in a few months' time.

Among 100-MHz units, the Micron P100 Millennia (\$3,299) holds promise. In the 75-MHz class, the Maximus Magna Media (\$2,195), Reason Square 5-LXP/IP-75 (\$2,495), and USA Flex PT-75 (\$2,595) were also good values.

NEXGEN: NOT SO COMPELLING

This first roundup of machines based on the Nx586 CPU left us a bit disappointed. Few matched the performance of comparably priced Pentium machines, and all used VL-Bus rather than PCI.

**QUAD-SPEED CD-ROM DRIVES**

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because their customers demand it.

The Triton chip set also lets system manufacturers use an enhanced type of

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Processor	486DX2/66	Pentium 75MHz	Pentium 75MHz
Processor Upgradable	Yes	Yes	Yes
Std./Max. Memory	8MB/136MB	8MB/192MB	16MB/192MB
Hard Drive	420MB	420MB	720MB
Cache Internal	8KB	16KB	16KB
Cache External	256KB (optional)	256KB	256KB
Local Bus Graphics	PCI	PCI	PCI
Video Memory/Max.	1MB/2MB	1MB/2MB	2MB/4MB
Compaq SVGA Color Monitor	Yes	Yes	Yes
Diskette Drive	3.5" 1.44MB	3.5" 1.44MB	3.5" 1.44MB
Expansion Slots (Total)	3	4	5
Drive Bays (Total)	3	4	5
Ports: Serial/Parallel	1/1 (ECP)	1/1 (ECP)	1/1 (ECP)
Security Features	Yes	Yes	Yes
101-Key Keyboard, Mouse	Yes	Yes	Yes
Software Preinstalled	MS-DOS® 6, MS-Windows® 3.1	MS-DOS 6, MS-Windows 3.1	MS-DOS 6, MS-Windows 3.1
Energy Star Compliant	Yes	Yes	Yes
Warranty¹	3-Year	3-Year	3-Year

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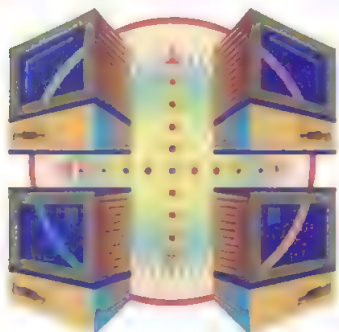
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synchronous SRAM that supports a pipelined-burst mode. But we haven't found any evidence that this pipelined-burst SRAM has a tangible impact on performance in today's implementations. It might make a difference if CPU buses were running at 75 MHz or faster, but right now the Pentium's external bus op-



ENHANCED CONNECTIVITY

More PCs are supporting network management capabilities to make asset tracking easier, and infrared interfaces are simplifying data interchange.

erates at either 50 MHz (for the 75-MHz chip), 60 MHz (for the 60-, 90-, and 120-MHz versions), or a maximum of 66 MHz (for the 66- and 100-MHz versions).

Because maximizing CPU-to-memory bandwidth is so critical, NexGen actually adopted a unique bus structure that makes its CPU's pinout incompatible with that of the Pentium. Most machines conceptually place the L2 cache between the processor and the system RAM; NexGen machines split the cache and system RAM on two isolated buses that run at different clock speeds (see the diagram "Pentium and Nx586: Key Differences"). The L2 cache controller is not contained in the core-logic chip set but is integrated onto the processor itself. An advantage of this design is that the CPU communicates with L2 cache at its full clock speed and without interference from the traffic on the main-memory and I/O buses.

This memory design is remarkably similar to that used by Intel's P6 Pentium successor (although the Nx586 does not incorporate L2 cache into the same package as the processor itself, as the P6 does). But being forward-looking has its downside: The Nx586 requires unique chip sets and motherboard designs. And right now, NexGen is the sole

supplier of Nx586 chip sets and is producing only VL-Bus versions of the chip set. By the time you read this, however, VLSI will be in the sampling stages of a NexGen chip set for PCI. If you want PCI—and you should, because that's where most system and peripheral vendors are focusing their design efforts—you'll have to choose a Pentium machine or wait until NexGen revs its chip set. NexGen chips also lack a built-in floating-point coprocessor, a standard feature of Intel's Pentium family.

COMPONENTS AND PERIPHERALS

Although the most fundamental changes to system design appear on machines' motherboards, components and peripherals are also breaking new ground. One hot area is CD-ROM drives: Almost overnight, quad-speed CD-ROM drives have displaced double-speed models. There's more: We've seen prototype 6x CD-ROM drives from Plextor; Packard Bell (not included here) sells machines with two CD-ROM drives, and Gateway's P5-120 includes a quad-speed drive with a three-CD changer. And already manufacturers are considering built-in CD recorders, which are dropping rapidly in price; you'll see these in shipping systems by year's end.

This attention to CD-ROM drives ties into a broader push into multimedia—even in business environments. Some manufacturers, such as NEC Technologies, are targeting corporate multimedia with gusto. This scenario will become more common as rudimentary audio capabilities come down even further in price. Intel's Native Signal Processing (NSP) strategy is one step in that direction: It provides a framework that lets high-speed CPUs perform many of the sound-processing tasks traditionally delegated to specialized Digital Signal Processing (DSP) chips. Though NSP support won't replace dedicated sound cards, it should make baseline audio capabilities available on nearly every machine.

At the opposite extreme, Hewlett-Packard refused to install a sound board in the machines it submitted for this evaluation. We understand the reasoning: Customers may not want to spend an extra \$79 on each of 1,000 machines. But

RECENT REVIEWS

Multimedia Marvels

April 25, 1995.....page 189
7 notebooks equipped with CD-ROM drives.

Power to Go

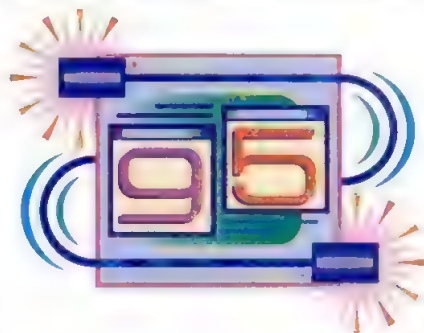
January 24, 1995.....page 108
68 color notebooks.

For Love or Money

December 6, 1994.....page 110
165 PCs: 486DX2/66s to Pentium/90s.

consider this: All of the major office suites include integrated audio support; imagine your machine literally talking you through a complex mail-merge operation, for example. Spend the money now; you'll experience the return on your investment when your IS department doesn't have to pull the cover off 10 or 1,000 machines and worry about resolving IRQ conflicts.

Speaking of IRQ conflicts, you should probably be looking ahead to Microsoft Windows 95 if you're thinking about purchasing a machine today. One of Windows 95's great promises is to provide a



PLUG AND PLAY SUPPORT

Plug and Play BIOSes lay the foundation for painless upgrades once Windows 95 ships.

foundation for true Plug and Play capabilities—no more flipping DIP switches on expansion cards. To provide the best infrastructure for these capabilities, look for a machine that provides a Plug and Play BIOS in Flash memory. At the very least, get one with a flash BIOS, so you can download an update—then lean on your vendor to make that update available. The same goes for PCs using OS/2, for

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Wing Commander
III

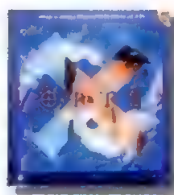
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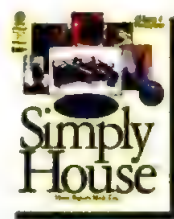
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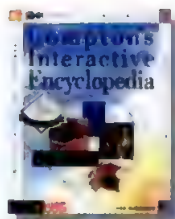


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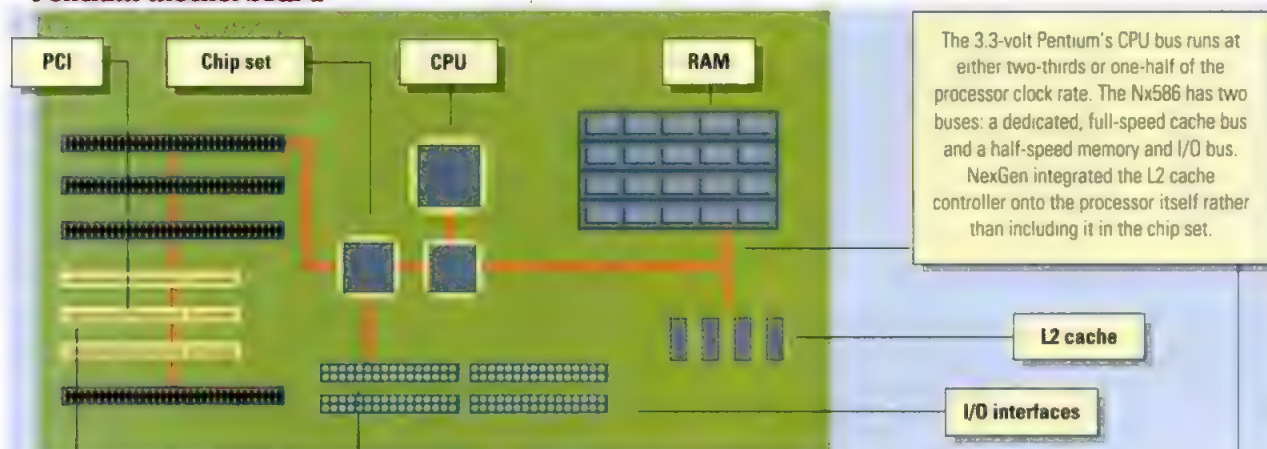
CIRCLE 363 ON READER SERVICE CARD



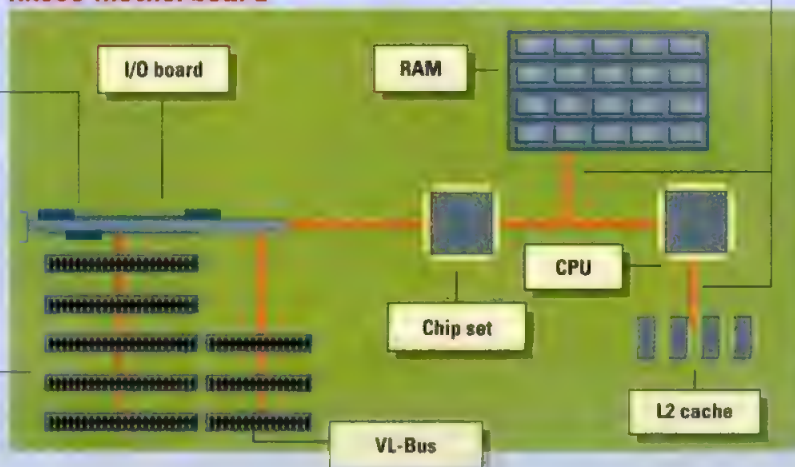
Pentium and Nx586: Key Differences

Compare a Pentium and an Nx586 system and you'll find it's not just the CPUs that are different. The two processors require entirely different motherboard designs. And although our past tests showed that Nx586 systems could perform on a par with Pentium machines, the components of the Nx586 systems in this roundup could

Pentium motherboard



Nx586 motherboard



Pentiums almost universally support PCI, but NexGen's chip set currently supports only VL-Bus for high-speed data transfers

which IBM has pledged Plug and Play support as well.

BELLS AND WHISTLES

Looking slightly further ahead, there are a few additional technologies that will help shape the future direction of the PC platform. Some of these are fairly simple performance enhancers, such as the Enhanced IDE Mode 4 PIO specification, which lets hard disks transfer data at 16.7 MBps, as opposed to the existing Mode 3 rate of 11.4 MBps. Others are more esoteric: Infrared capabilities, for example, promise to let you transparently zap files back and forth between your PC and your notebook or eliminate the cable that ties your PC to your printer. HP's newest LaserJets and many of its desktops sup-

port the IrDA (Infrared Data Association) standard that enables this sort of exchange, and notebook manufacturers are beginning to sign on too.

WHAT TO LOOK FOR

If you're looking for price/performance, 75-MHz Pentium systems are the place to start your search. If you need more power, consider both 90- and 100-MHz CPUs. Unless you absolutely demand the ultimate in performance, don't go after the 120-MHz Pentium yet: You'll find the 20 percent performance improvement may not justify the expense.

We can't recommend a Nx586-based system today. Though we think NexGen's CPUs have potential and we're pleased to see companies take on Intel at

the high end of the CPU market, the lackluster performance of early NexGen machines and the current lack of PCI support make them unappealing choices at the moment.

Components such as EDO DRAM and pipelined-burst cache will boost performance slightly, but probably not enough that you'll notice the difference unless you run sensitive benchmark tests such as Winstone 95. So base your buying decision on tangible features, including the presence of a Plug and Play BIOS, quad-speed CD-ROM drives, high-resolution monitors, and capacious hard disks. And look for value-added features such as network management capabilities or bundled remote-diagnostics software.



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Aberdeen Inc.

Aberdeen NxP100 Aberdeen P100-PCI

The \$3,499 Aberdeen P100-PCI, built around a Pentium/100 processor and targeted toward power users, garnered solid scores on most of our benchmark tests. If money's tight, though, consider the lower-cost Aberdeen NxP100 (\$2,899), which uses NexGen's 93-MHz Nx586 CPU. Expansion room, not performance, is the only trade-off.

The NxP100 garnered scores somewhat lower than those posted by its Pentium counterpart, with one exception: Disk WinMark 95. Despite the 32-bit file access feature offered by Windows for Workgroups, the P100-PCI's Disk WinMark score was among the lowest of the Pen-

tium/100 systems tested, and the NxP100 outscored the P100-PCI by 40 percent on these tests. Both systems' Graphics WinMark 95 and Winstone 95 results were average.

Unlike the P100-PCI, which has integrated I/O, the NxP100 uses a VL-Bus slot—a setup which was typical for the NexGen-based systems in this review.

Ports coming off the I/O card block another slot, leaving three empty slots compared with the P100-PCI's five. Both systems had two available drive bays.

These mini-tower systems came with quad-speed CD-ROM drives, a set of MidiLand speakers, a Diamond Stealth 64 graphics card, a Sound Blaster 16 sound card, a 1GB hard disk, and five home-oriented CD-ROM titles (you can opt for a four-CD business-oriented bun-

In Short and Service & Reliability Ratings: Pentium and Nx586 PCs

Our **In Short** statement for each review conveys our impressions of the systems covered—what their distinguishing features are and how well they meet the requirements of their target audiences.

Service & Reliability

For our 1995 Service & Reliability survey, we sent questionnaires to 17,000 randomly selected PC

dle instead). Aberdeen shipped the P100-PCI with a 17-inch monitor, a \$299 upgrade over the 15-inch monitor that came with the NxP100.

A two-year warranty on parts and free labor for the systems' lifetime round out the packages.—Jodi L. Wynblatt

Aberdeen Inc., Santa Fe Springs, CA;
800-552-6868, 310-801-5626; fax, 310-801-5629.

Circle 461 on reader service card

Acer America Corp.

AcerAcros Pentium 75 AcerPower Pentium 120

The \$3,499 AcerAcros Pentium 75 represents Acer's line of retail multimedia PCs; the \$4,245 AcerPower Pentium 120, Acer's business PCs. Both performed well on our tests and came with good—and appropriately targeted—software bundles.

The 75 mini-tower PC is one of few units in this roundup to offer telephone, fax, and answering machine features. It also comes with the Acer Computer Explorer (A.C.E.) preinstalled. This Windows front end helps you set up both hardware and software and has other features to guide novice users. The 75 also comes

Magazine subscribers; about half responded. We publish results only for those vendors for which we received at least 50 responses, the minimum required for statistically projectable results.

Users rated their satisfaction with

the overall reliability of each system, with their experiences in getting the PC repaired, and with the vendor's technical support.

For more information on the survey methodology and results, refer to our issue of January 10, 1995.

with family-oriented titles, such as Micro-soft Encarta and Intuit's Quicken.

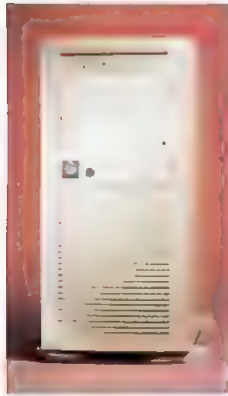
The 120 mini-tower lacks the 75's A.C.E. software and its 14.4-Kbps data-fax modem. What it does have is a Triton-based motherboard with pipelined-burst cache; also, Microsoft Office is preloaded. The 120's graphics subsystem is based on a Diamond Stealth 64 graphics accelerator with 2MB of VRAM, while the 75 uses an ATI Graphics Pro Turbo card with 4MB of VRAM.

The AcerAcros Pentium 75 and AcerPower Pentium 120 both came with 17-inch monitors and quad-speed CD-ROM drives. Within their respective CPU groups, test results were average for both machines.

Both systems include three-year parts-and-labor warranties and are backed by 24-hour, 7-day technical support.—William P. Flanagan

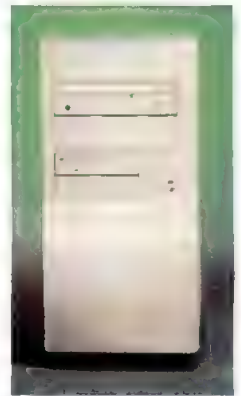
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IN SHORT

The NxP100 and P100-PCI are reasonably priced and offer fair performance.



IN SHORT

Acer offers solid PCs for both home and business users.

SERVICE & RELIABILITY

Reliability	Above average
Repair service	Above average
Tech support	Average

Our Contributors: JOHN CLYMAN is an associate editor at *PC Magazine*.

ANGELA R. HICKMAN, CAROL VENEZIA, and ANUSH YEGYAZARIAN are staff editors at *PC Magazine*. ROBERT S. ANTHONY is a senior writer and WILLIAM P. FLANAGAN is a staff writer at *PC Magazine*. JODI L. WYNBLATT is a senior editorial researcher and MARY E. BEHR is an editorial researcher at *PC Magazine*. MARC D. SAURBORN is a consultant to PC Labs. RICHARD FISCO was the project leader for this story.

ACMA Computers Inc.

ACMA P75 ACMA P100

ACMA positions the ACMA P75 (\$3,195) and the ACMA P100 (\$3,995) both as family PCs and as workstations for the small business or home office. These two systems include a full complement of multimedia components and a small software bundle (Microsoft Works and Microsoft Encarta), but they lack the user-friendly design and numerous other amenities we've come to expect in PCs targeted to those audiences.

These machines have almost identical components, with two exceptions. On the motherboard, the ACMA P100 pairs a



IN SHORT

These home-oriented systems have solid components but few amenities.

100-MHz Pentium processor with Intel's new Triton chip set, while the ACMA P75 uses a 75-MHz Pentium and the older Neptune chip set. And the P100 uses a 1.2GB hard disk, while the P75 uses an 812MB model.

Each system is housed in a nine-bay tower case and has plenty of available PCI and ISA slots. Each also uses a Diamond Stealth graphics accelerator and a top-quality 17-inch MAG InnoVision monitor. And each uses a quad-speed CD-ROM drive that connects to the proprietary interface on its installed Creative Labs Sound Blaster 16 card, rather than the ATAPI-compliant Enhanced IDE CD-ROM drives that most of the vendors in this roundup opted for.

The ACMA P75 achieved an above-average Disk WinMark 95 score but otherwise turned in average scores for its CPU group. The ACMA units' relative performances on our Winstone 95 tests correlate perfectly with their relative prices.—WPF

ACMA Computers Inc., Fremont, CA;
800-786-6888, 510-623-1212; fax, 510-623-0818.

Circle 463 on reader service card

Price/Performance Index: Pentium and Nx586 PCs

If you're seeking a machine that has it all—with an emphasis on great features and performance—look no further than the \$3,499 Austin Power Plus 100, one of our Editors' Choice winners. It had the second-highest performance/features score of any PC in this roundup, thanks to features such as a 28.8-Kbps modem, an infrared port, and excellent performance on our Winstone 95 tests. The system is backed by a three-year warranty.

The Tri-CAD NTP100 Personal Workstation actually had the best performance/features rating. But its price of \$5,999 far outweighs its performance/features advantage, although it does offer a variety of extras oriented toward high-end graphics applications—among them a 21-inch monitor.

The \$3,340 Gateway P5-100XL, another Editors' Choice winner, also provides nearly as complete a package at a price that's even better than the Austin's. Though it lacks a modem, it includes Altec Lansing speakers with a subwoofer, and it had the best Winstone 95 score of any 100-MHz Pentium system we tested.

Two more leaders are the Gateway P5-120 and the Micron P120 Millennia (both Editors' Choices). Of the two, the \$4,299 Gateway PC leads in terms of features, with a three-CD changer, a 17-inch monitor, the same Altec Lansing speaker package as its Pentium/100 sibling, and a 14.4-Kbps voice modem. The P120 Millennia offers nearly as much hardware—the notable exception being its 15-inch screen—and adds Microsoft Office, for a price that's \$500 lower.

If you're looking for value, three machines that earned honorable mentions fill the bill: the Maximus Magna Media (\$2,195), the Reason Square 5-LXP/IP-75 (\$2,495), and the USA Flex PT-75 Desktop System (\$2,595). Low prices are key to these systems' impres-

sive showing on this chart, but there's more: The Maximus machine has a massive tower case with virtually unparalleled room for expansion, and the other two systems are backed by impressive warranties that helped boost their performance/features scores.

The \$1,995 Blackship NX-80 Nautilus, based on the NexGen Nx586-P80, is the least expensive system here. It can't, however, match the performance and features that the Maximus system offers for only \$200 more.

The \$2,699 Austin Power Plus 75—an Editors' Choice—also has an enviable spot on our chart. Although it's not as inexpensive as many of the 75-MHz Pentium PCs here, it offers a wealth of features few can match, including a 19.2/14.4-Kbps data/fax modem and wavetable-synthesis sound. And yet this system's price is competitive with that of many other more sparsely equipped systems.—*Analysis written by Anush Yeghazarian*

THE DATA POINTS

Scores on our benchmark tests—primarily our Winstone 95 tests—account for just under half of the total price/performance rating. Features such as the diagonal screen size and maximum refresh rate of the monitor, and speed of the included fax/modem (if any) make up around 20 percent of the total. Expansion capability, which includes the number of free slots and drive bays and the maximum amount of RAM supported, makes up about 10 percent of the score. Service and support considerations, such as warranty length and the availability of free on-site service and 24-hour, 7-day telephone support, constitute a bit more than 10 percent as well. Other features, such as Plug and Play BIOS and the size of graphics memory, make up the remainder of the score. For more information, look in the Hardware Library of the Editorial Forum on PC MagNet under 10BANG95.TXT.

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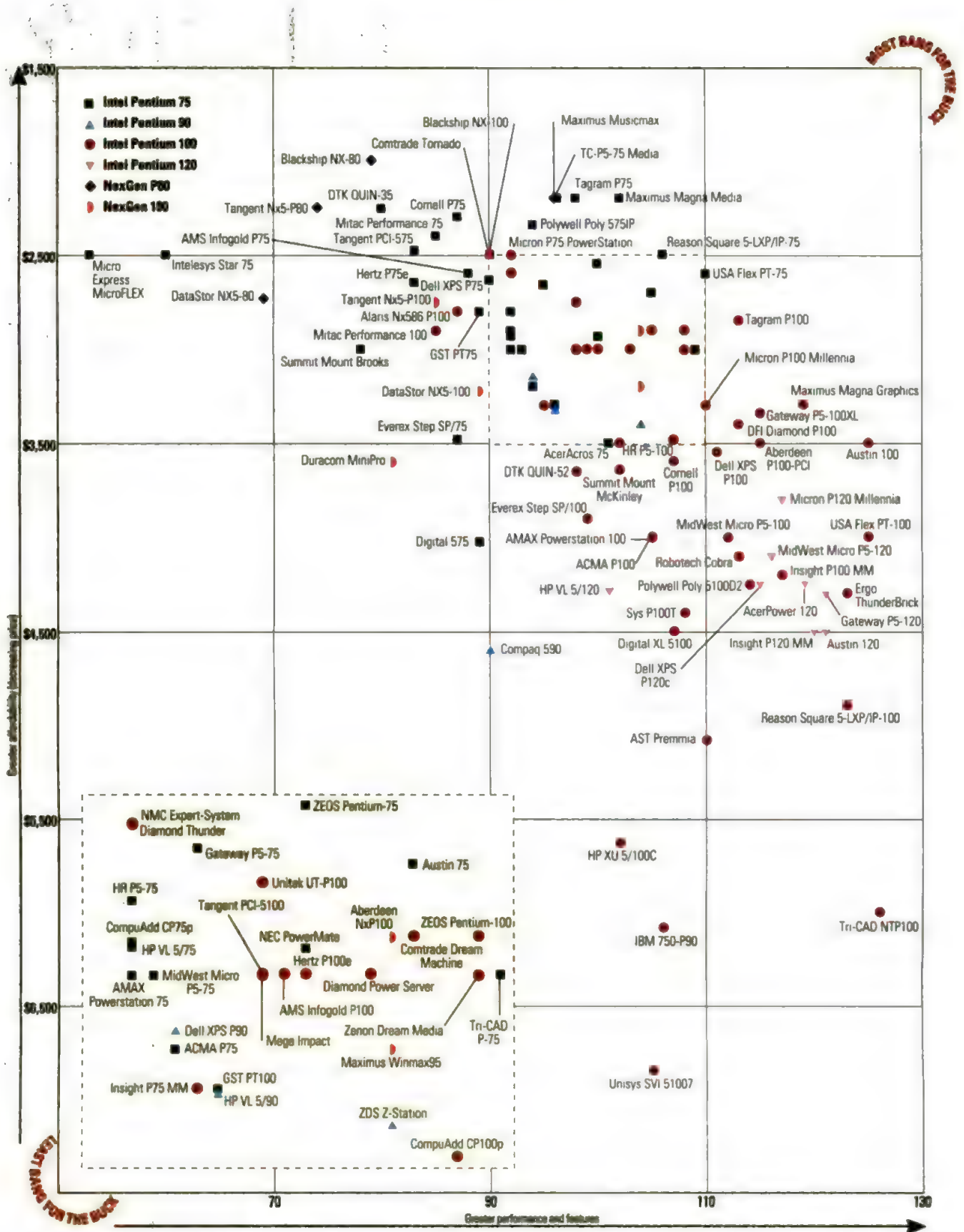
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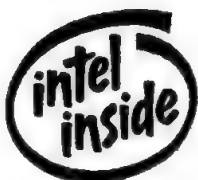
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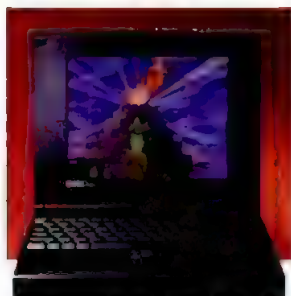


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Alaris Inc.

Alaris Nx586 P100

Alaris targets the business user with its \$2,798 Alaris Nx586 P100, but the tower system's reliance on VL-Bus technology and its mediocre performance on our benchmark tests make it a lackluster choice. Faster, more capable Pentium systems are available for similar or lower prices.

Alaris manufactures many of the Nex-Gen Nx586 motherboards used in the machines in this roundup, but—as we see here—it hasn't performed any tuning or additional integration that would help differentiate its own products.



IN SHORT

This Nx586-based unit has unimpressive performance at an unremarkable price.

The unit posted performance scores that were solidly average compared with the other Nx586-P100 systems. Despite the 93-MHz speed of its processor and Nex-Gen's claim of comparability with 100-MHz Pentium PCs, the unit's Winstone 95 and Disk WinMark 95 scores were more in line with those of 75 MHz Pentium-based systems. In a few areas—notably graphics performance—the machine did approach the performance of 90-MHz Pentium systems.

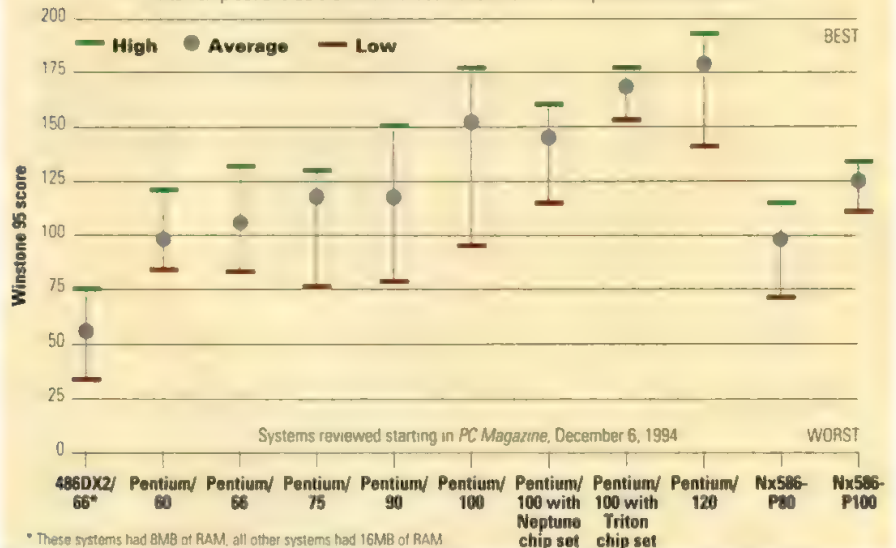
The unit itself is like any tower system, with plenty of open drive bays for additional mass-storage devices. Installed components include a 1GB hard disk and a Matrox MGA VL-Bus-based graphics accelerator with 2MB DRAM, as well as a Creative Labs Sound Blaster 16 sound card and a double-speed CD-ROM drive. Like many of the other NexGen-based units reviewed here, the Alaris unit had no available VL-Bus slots in the configuration we tested.

Alaris backs this system with a three-year parts-and-labor warranty.—WPF
Alaris Inc., Fremont, CA; 800-317-2348, 510-770-5700; fax, 510-770-5769.

Circle 464 on reader service card

System Performance by Processor Type

It's no surprise that the top Winstone 95 scores were generated by systems with 120-MHz Pentium CPUs. But the real story is in the chip sets: The top-performing Pentium/100 and Pentium/120 PCs all used Intel's new Triton chip set and EDO DRAM. Nx586-based PCs did not perform well overall.



* These systems had 6MB of RAM, all other systems had 16MB of RAM

AMAX Engineering Corp.

AMAX Powerstation 75 AMAX Powerstation 100

The on-par performance of the 75-MHz Pentium-based AMAX Powerstation 75 (\$2,999) makes the system a good value for its target small-business and home-office market. For the long haul, however, the Pentium/100-based AMAX Powerstation 100 (\$3,999), which yields 25 percent better performance under Windows and has a finer assortment of components, is an even better investment.

The main difference between the two Powerstations is in their arsenal of multimedia-related components. The AMAX Powerstation 75 includes a 15-inch MAG monitor, generic stereo speakers, and a TEAC quad-speed CD-ROM drive. On the Powerstation 100, AMAX upgraded these items to a 17-inch MAG Innovision moni-

tor, Sony stereo speakers (with subwoofer), and a Toshiba quad-speed CD-ROM drive, easily bridging the price gap.

Both of the AMAX systems also include a 1.1GB hard disk, a Creative Labs Sound Blaster 16 sound card, and a Diamond Stealth graphics accelerator with 4MB of VRAM.

The Powerstation 100, which had a Triton chip set, and the Powerstation 75, which had a Neptune chip set, posted above-average scores on our Disk WinMark 95 tests. Winstone 95 and Graphics WinMark 95 scores for both these systems were average within their respective processor classes. The Powerstation 100's scores were somewhat lower than those of other Triton-based systems, however, because it lacked the EDO DRAM found in most of the others.—WPF

AMAX Engineering Corp., Fremont, CA; 800-800-6328, 510-651-8886; fax, 510-651-4119.

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American MultiSystems

AMS Infogold P75 AMS Infogold P100

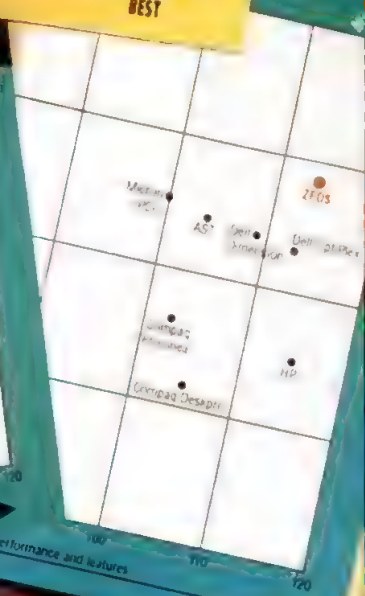
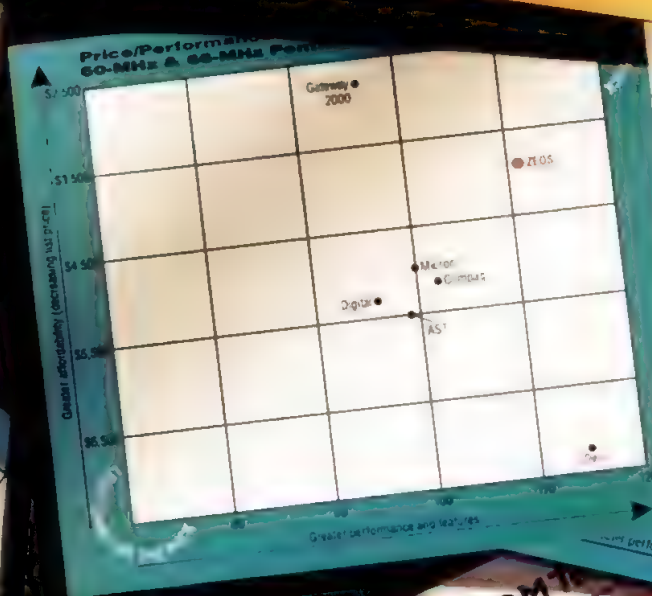
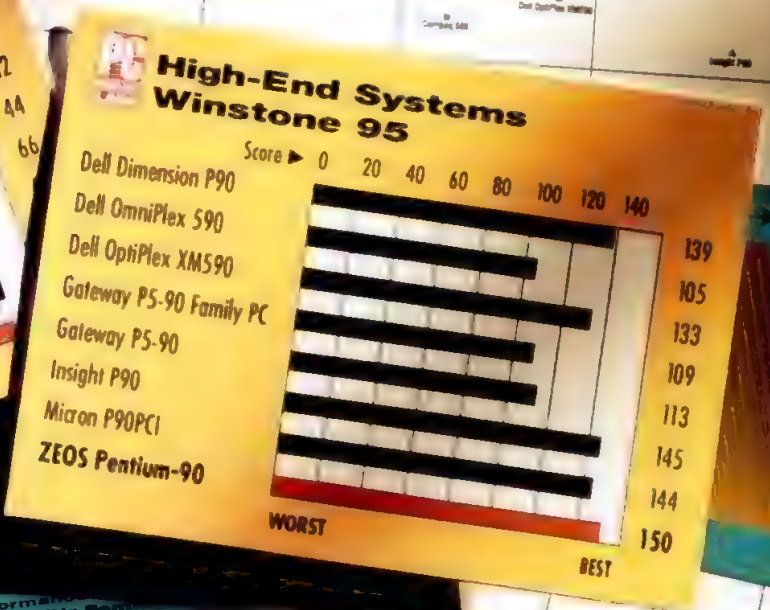
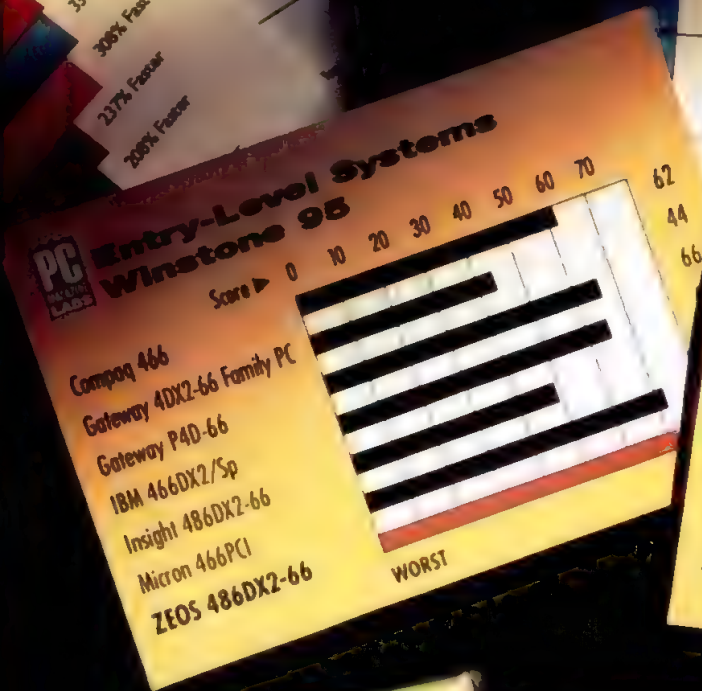
Average performance at a better-than-average price makes for an appealing combination. At \$2,595 and \$2,995, respectively, the AMS Infogold P75 and AMS Infogold P100 supply a



IN SHORT

These run-of-the-mill PCs are a fair value; the 100-MHz system is the better buy.

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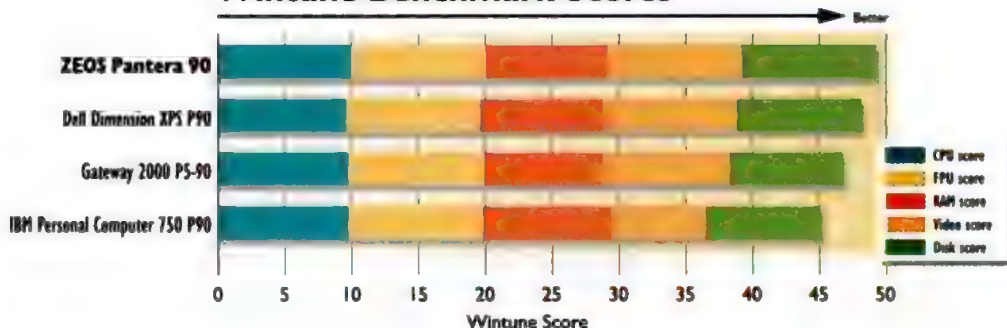




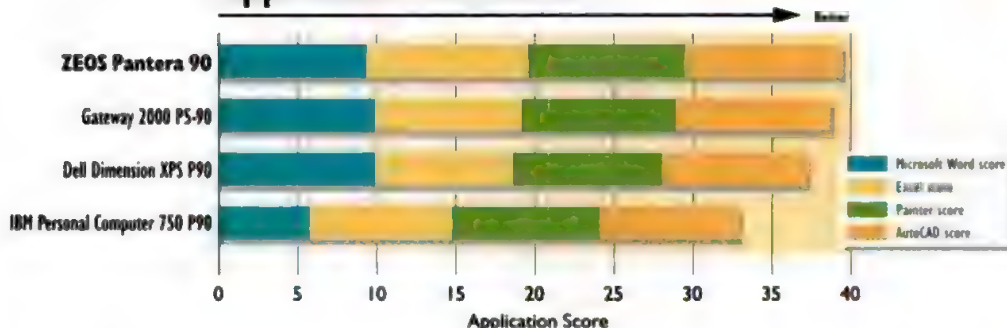
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— Windows Magazine,
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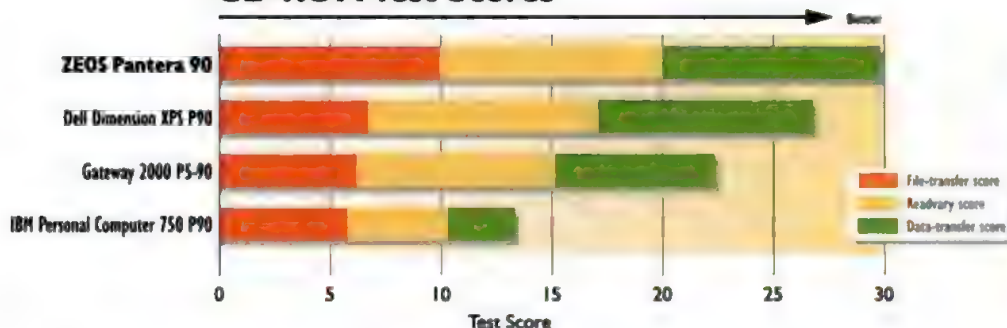
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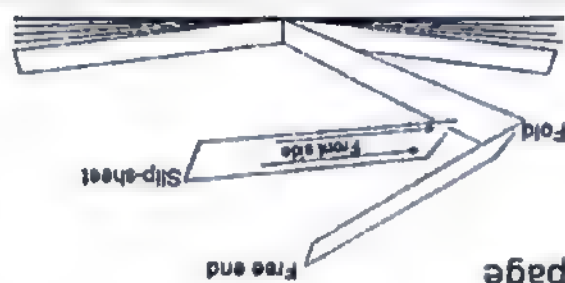
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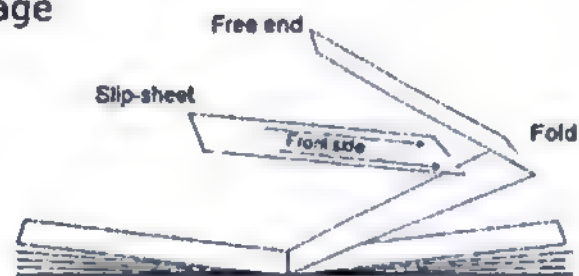


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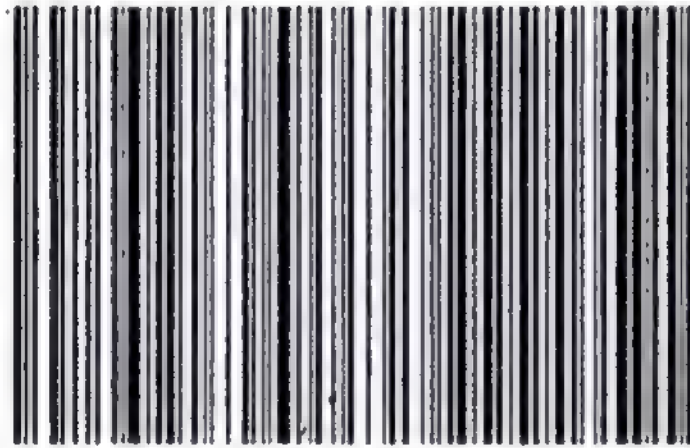
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486DX2-66 \$1645
Pentium-60 \$1895
Pentium-75 \$1945

Package #2:

- 8MB RAM
- 850MB local bus IDE hard drive
- 4X CD-ROM drive, 3.5" 1.44MB FDD
- Diamond Stealth 64-bit PCI local bus SVGA graphics card with 1MB DRAM
- 14" SVGA color monitor
- 6-bay desktop case
- MS-DOS, Windows for Workgroups, Microsoft Mouse



Pentium-75 \$2395

Top Gun:

The above system modified to include:

- 256K SRAM cache
- Diamond Stealth 64 Video PCI local bus graphics card with 2MB VRAM upgrade
- 15" SVGA color monitor upgrade
- 14.4/14.4 send/receive fax modem
- Lotus SmartSuite



Pentium-75 \$2545
Pentium-90 \$2745
Pentium-100 \$2895
Pentium-120 \$3195

Hottest:

- 16MB RAM, 256K SRAM cache
- 1GB local bus IDE hard drive
- 4X CD-ROM drive, 3.5" 1.44MB FDD
- Diamond Stealth 64 Video PCI local bus graphics card with 2MB VRAM upgrade
- 15" SVGA color monitor
- 6-bay desktop case (Pentium-75)
- 10-bay vertical case (Pentium 90, 100 & 120)
- MS-DOS, Windows for Workgroups, Microsoft Mouse
- Lotus SmartSuite



Pentium-75 \$2995
Pentium-90 \$3145

Best MM:

- 16MB RAM, 256K SRAM cache
- 850MB local bus IDE hard drive
- 4X CD-ROM drive, 3.5" 1.44MB FDD
- 16-bit sound card, stereo speakers
- Diamond Stealth 64 Video PCI local bus graphics card with 2MB VRAM upgrade
- 17" SVGA color monitor
- 10-bay vertical case
- MS-DOS, Windows for Workgroups, Microsoft Mouse
- Lotus SmartSuite

Pentium-90 \$3695
Pentium-100 \$3845
Pentium-120 \$4145

Best MM Supreme:

The above system modified to include:

- 24MB RAM
- 1.2GB local bus IDE hard drive
- High-power speakers w/ subwoofer



486DX2-66 \$1395

Package #2:

- 8MB RAM, 128K SRAM cache
- 528MB hard drive
- 3.5" 1.44MB floppy drive
- VESA local bus SVGA color video
- 14" SVGA color monitor
- 4-bay desktop case
- MS-DOS, Windows for Workgroups, Microsoft Mouse



486DX2-50 \$2995
DX4-100 \$3395

Package #2:

- 8MB RAM
- 350MB IDE hard drive
- External 3.5" 1.44MB floppy drive
- 7.9" display active matrix color VGA
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- Lotus Organizer
- 7.8" x 10.2" x 1.7"; 4.1 lbs.



Pentium-75 \$3995

Package #2:

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- Custom carrying case
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- Lotus Organizer
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CIRCLE 155 ON READER SERVICE CARD.



IN SHORT

The Infogold machines offer average performance and won't break the bank.

The 100-MHz Pentium system came in a large tower case that housed a 1GB Fast SCSI hard disk connected to a PCI SCSI controller, and a Diamond Stealth 64 graphics accelerator card with 2MB VRAM. The 75-MHz Pentium unit came in a mini-tower case that was configured with a 540MB IDE hard disk and a Diamond Multimedia graphics card with 2MB of DRAM.

On our benchmark tests, these units posted middle-of-the-road scores on all of

solid set of components that offer fair performance and won't break the bank.

Both systems used motherboards built around Intel's Neptune chip set. The machines also included 14.4-Kbps fax modems and 1-inch Sony monitors. The 100-MHz Pentium-based P100 came with a quad-speed CD-ROM drive, as did the 75-MHz Pentium P75.

our Windows-based benchmark tests. Both of these AMS units posted Winstone 95, Graphics WinMark 95, and Disk WinMark 95 scores that were on par with those of other systems in their respective processor classes.

Although American MultiSystems does not offer 24-hour, 7-day telephone support, the company says it monitors the traffic on its electronic mail account on America Online (infogold2@aol.com) at 2-hour intervals around the clock. —WPF

American MultiSystems, Sunnyvale, CA;
800-888-6615, 408-524-9091; fax, 408-524-9099.

Circle 466 on reader service card

AST Research Inc.

Premmia GX P/100

At \$5,080 (street price), AST's Premmia GX P/100 is one of a handful of systems in this roundup that shows careful attention to design detail. This business-oriented PC's relatively high price is partly attributable to an EISA/PCI motherboard with more integrated components and greater expandability than most; the unit had average performance on our benchmark tests. AST also sells the value-oriented Bravo



IN SHORT

The Premmia provides EISA slots, Ethernet, and a thoughtful design—for a price.

SERVICE & RELIABILITY

Reliability	Average
Repair service	Average
Tech support	Average

line through resellers, and the Advantage line in retail outlets.

The system's motherboard supports two CPUs and up to 192MB of RAM. Connectivity is one of the

Premmia's strong points: Its integrated 16-bit Ethernet has both 10BaseT and AUI connections. A SCSI-2 port makes adding external devices relatively painless. The system's case is also thoughtfully designed with features such as clearly labeled ports, rail-mounted hard disks, and thumbscrews to make the Premmia easy to service and upgrade.

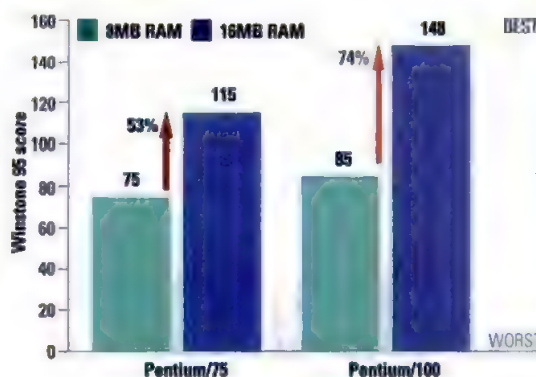
This desktop's riser card supports up to three full and two half-height EISA or ISA cards, and two PCI cards. An ATI Graphics ProTurbo PCI graphics controller with 2MB of VRAM, double-

Memory: The Sweet Spot

Don't underestimate the impact that RAM has on performance; skimping on memory can throttle even the speediest CPU. We retested a handful of machines after we reduced their RAM from 16MB to 8MB and saw performance take a dive. On our Winstone 95 tests, Pentium PCs with 8MB of memory were barely faster than the best 486DX2/66 machines we've seen.

Upping RAM to 16MB translates into a performance boost of about 50 percent for Pentium/75s and an amazing 74 percent for Pentium/100s. Part of this increase comes from the use of a 4MB disk or file cache on a 16MB system, which compares with 2MB on

an 8MB machine. That mimics Microsoft's recommendations and real-world usage. (Don't bother trying a 4MB cache on an 8MB system; Windows will swap to disk constantly, and your PC will seem perpetually sluggish.)



What happens if you ratchet memory up to 32MB? Not much: We found a gain of only 1 to 2 percent over the 16MB configurations—not enough for us to graph, and not enough to warrant the \$500-plus cost of the upgrade for typical users. (The performance difference would be more dramatic for users who work with extremely large files in applications such as photo retouching.)

Results shown are an average of Winstone scores garnered by 75-MHz units from Acer America Corp., ACMA Computers, Comtrade, and Tri-Star Computer and 100-MHz machines from Cornell Computer Systems, Diamond Technologies, and Hewlett-Packard Co. □

speed CD-ROM drive, and 16-bit sound card round out the package.

The Premia produced average scores on all of our benchmark tests. The system is covered by a three-year parts-and-labor warranty, with 24-hour, 7-day telephone technical support.—*Marc D. Sauborn*

AST Research Inc., Irvine, CA; 800-876-4278, 714-727-4141; fax, 800-926-1278.

Circle 467 on reader service card

Austin, a division of IPC Technologies

Austin Power Plus 75 Austin Power Plus 100 Austin Power Plus 120



The \$2,699 Power Plus 75, \$3,499 Power Plus 100, and \$4,499 Power Plus 120 are representatives of a feature-rich line of Pentium PCs from Austin, a division of IPC Technologies. The Power Plus 100 and Power

Plus 75 both offer a great mix of performance and features; they have been selected as two of our Editors' Choices for this roundup. Austin also sells the 486-based Genesis and Premier lines.

All three Austin systems were configured with quad-speed CD-ROM drives. For sound and communications, the Power Plus 75 uses a Media Magic Telemetry-



IN SHORT

Great features and respectable performance make these machines good buys.

SERVICE & RELIABILITY

Reliability	Average
Repair service	Average
Tech support	Average

32 multipurpose board that integrates 16-bit wave-table sound, a 19.2/14.4-Kbps data/fax modem, and even gives you voice mail and speaker phone functions.

On the Power Plus 100's motherboard is an integrated 16-bit sound connector whose cable is routed to the front of the mini-tower case, where you'll also find the speaker and microphone jacks, along with an

IrDA-compliant infrared port—a forward-looking feature not found on any other system in this roundup. The Power Plus 100 and the Power Plus 120 also include a 28.8-Kbps fax modem, as well as a 17-inch monitor.

On our benchmark tests, the Power Plus 75 and Power Plus 120 were average performers in their processor classes. The Power Plus 100 did extremely well on our Winstone 95 tests, producing a score that placed it in the top five of all the systems tested for this roundup. Its Graphics WinMark 95 and Disk WinMark 95 scores were average.—*Carol Venezia*

Austin, a division of IPC Technologies, Austin, TX; 800-622-5506, 512-339-3500; fax, 512-454-1357.

Circle 468 on reader service card

Blackship Computer Systems Inc.

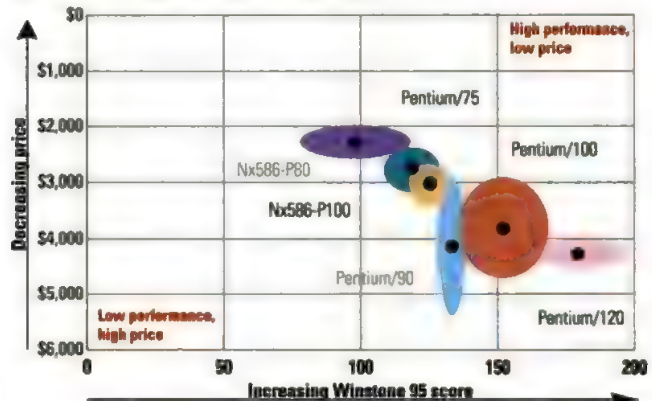
Blackship NX-80 Nautilus Blackship NX-100 Nautilus

The \$1,995 NX-80 Nautilus and the \$2,495 NX-100 Nautilus offer extremely low prices at the expense of performance. Blackship markets these Nx586-based systems both as cost-effective PCs for the small office or home office and as Windows workstations for business users. But they don't stand out either way: The absence of a software bundle makes these machines an unlikely candidate for the home, and as Windows workstations they're lacking badly in graphics performance.

The NX-100 differs only minimally from the NX-80: It uses a slightly faster CPU; it has a 1GB disk instead of a 504MB model; and it includes a 250MB QIC tape backup unit (a \$179 option). Both systems are crowded internally, and

Comparing the Chips

As you would expect, increased performance correlates closely with a higher price tag. Note, however, that Pentium/100 systems provide better performance than Pentium/90 PCs, even though both fall into similar price ranges. Nx586-P80 units are slower and less expensive than Pentium/75 systems, and Nx586-P100 systems are near matches for Pentium/75 PCs.



This chart indicates the relative prices and system-level performance of machines based on different CPUs. Black dots mark the average prices and Winstone 95 scores of systems in six CPU groups, and shaded areas show the ranges of typical values. Each shaded area encompasses roughly two-thirds of the machines in the specified CPU class and represents values within one standard deviation from the mean, statistically speaking.

expandability is limited because I/O is not integrated on the motherboard. Neither machine offered a free VL-Bus expansion slot; only two ISA slots were available.

The NX-80's Winstone 95 score was average for Nx586-P80 systems but substantially lower than the scores of most Pentium/75 units tested. The same was true of the NX-100: Its test scores were average among Nx586-P100 systems but subpar relative to Pentium/100 machines. Blackship's choice of a 32-bit Spider Graphics graphics accelerator card hurt both systems' Graphics WinMark 95 scores: Each system posted the lowest score in its processor group.—*WPF*

Blackship Computer Systems Inc., San Jose, CA; 800-531-7447, 408-432-7500; 408-432-1443.

Circle 469 on reader service card

IN SHORT

These units are low-priced but lacking in expandability.



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Valentin Gonzalez, Pfizer

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Tony Chen, DeAnza Systems

"We were working on a state bid when the power went off. APC saved the day and year and future...about 800 pages of data saved thanks to APC."

Ravi Iyer, Software Galleria

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C. Jeffrey, C. Jeffrey Eng.

"APC has virtually eliminated downtime in our corporate network."

Kurt Roemer, Searle Corp.

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Suzi Higginson, OSI Inc



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R. Morella, Westinghouse

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Craig Post, Comm. Tech.

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CIRCLE 201 ON READER SERVICE CARD

Compaq Computer Corp.

Deskpro XL 590 Model 535

With its integrated Ethernet and 17-inch monitor (a \$400 upgrade from the basic 15-inch model), the Compaq Deskpro XL 590 Model 535 is an attractive package for high-end business computing needs. Its performance was mostly competitive, although at the \$4,598 estimated selling price, it's one of the higher-priced systems in this roundup. Compaq's other PC lines (not reviewed) include the Deskpro for midrange business users, the ProLinea for entry-level business users, and the Presario for home users.

The EISA/PCI-based XL 590's processor sits on a proprietary card that also holds 16MB of RAM. Ethernet is integrated, as is a 16-bit sound subsystem. The included Vocalyst keyboard, which comes standard on all Deskpro XL PCs, has a built-in microphone, speaker, and mouse port, as well as microphone and headphone jacks and a thumb wheel for volume control.

Compaq originally sent us this machine without a CD-ROM drive and was unable to provide one by our deadline. For the most part, the Deskpro XL 590 was a competitive performer in its CPU group, although not as fast as 100-MHz systems. Its Graphics WinMark 95 score was the best of the group. The unit's only trouble spot was on the Disk WinMark 95 tests: Because it was running Windows 3.1, which doesn't offer performance-enhancing 32-bit file access, this unit couldn't keep up with its Windows for Workgroups-based competition.

Compaq includes a three-year warranty and one year of on-site service.—WPF

Compaq Computer Corp.,
Houston, TX;
800-345-1518; fax,
713-378-1442.

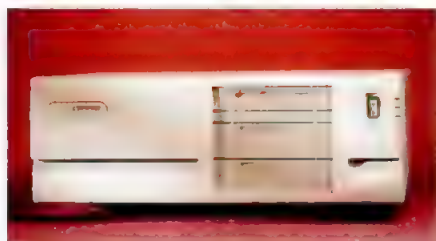
Circle 470 on reader
service card

IN SHORT

*The XL 590 comes
with extras
business users
will appreciate.*

SERVICE & RELIABILITY

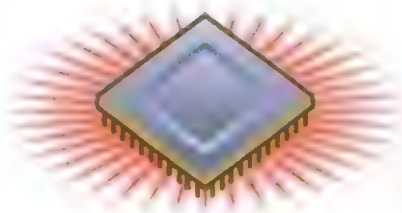
Reliability	Above average
Repair service	Above average
Tech support	Above average



CompuAdd Computer Corp.

**CP75p Desktop
CP100p Minitower**

CompuAdd, a direct marketer that emerged from Chapter 11 bankruptcy reorganization in 1993, aims its CP100p Minitower (\$3,482) at high-end business users and its CP75p Desktop (\$2,916) at mainstream corporate buyers. With its extremely strong performance and components, the CP100p is the better value.



**The performance of the CP100p
was above average, thanks to a
Trition chip set and EDO DRAM.**

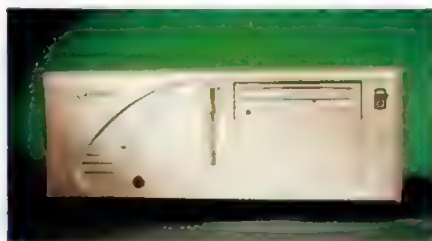
The CP100p uses a Pentium/100 CPU and came with a quad-speed CD-ROM drive, a 730MB hard disk, and an integrated 16-bit sound chip with wavetable synthesis. The system was a strong performer within its CPU group. Its Graphics WinMark 95 and Winstone 95 scores were above the average, and its CPUmark₁₆ score tied for highest among Pentium/100 machines. Part of the reason why this unit performed so well was its memory: The CP100p is one of only a handful of machines to use EDO DRAM, an advantage made possible by its Trition chip set. One downside of this approach, however, is that all four

IN SHORT

*Strong performance
and quality compo-
nents make these PCs
worth considering.*

SERVICE & RELIABILITY

Reliability	Average
Repair service	Average
Tech support	Above average



of its SIMM slots were used, so upgrading requires the removal of two modules.

The Pentium/75-based CP75p is powered by Intel's older Neptune chip set. It came with a quad-speed CD-ROM drive, 696MB hard disk, and a wavetable-capable Diamond Sonic LX sound card. Its performance was solidly average on all our Windows-based tests.

CompuAdd offers 24-hour, 7-day telephone support.—Mary E. Behr
CompuAdd Computer Corp., Austin,
TX; 800-627-1961, 512-250-1489; fax,
512-331-2862.

Circle 471 on reader service card

Comtrade

**Multimedia Tornado 4X P75
Multimedia Dream
Machine P100**

A reasonable price of \$2,895 combined with above-average Windows graphics performance makes the Comtrade Multimedia Dream Machine P100 worthy of consideration. For the most part, the same is true of the \$2,495 Comtrade Multimedia Tornado 4X P75. But the Dream Machine, with its speedier processor and extra room for mass storage expansion, is the better bargain.

The Pentium/75-based Tornado is housed in a minitower case with two empty drive bays. The Pentium/100-based Dream Machine's tower case provides plenty of space for growth.

Memory upgrades are somewhat inconvenient: Both systems require the removal of their drive cages. In the Tornado's case, all four of its memory banks were full, so upgrades will be at the expense of two SIMMs.

Comtrade included quad-speed CD-ROM drives with both systems. Both used a Diamond Stealth PCI-based graphics accelerator and an Orchid sound card. The Dream Machine had a 1GB hard disk, while the Tornado used a 773MB model.

On our benchmark tests these units proved to be solid Windows performers. The Winstone 95 scores of both were average in their respective processor classes. On the Graphics WinMark 95 tests, the Dream Machine produced

IN SHORT

*Comtrade combines
good performance
and a fair price, espe-
cially in the P75*

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Pentium Technology Value

- 75MHz Intel Pentium Processor
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- 64-Bit PCI Video Accelerator - 1MB
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\$1,799

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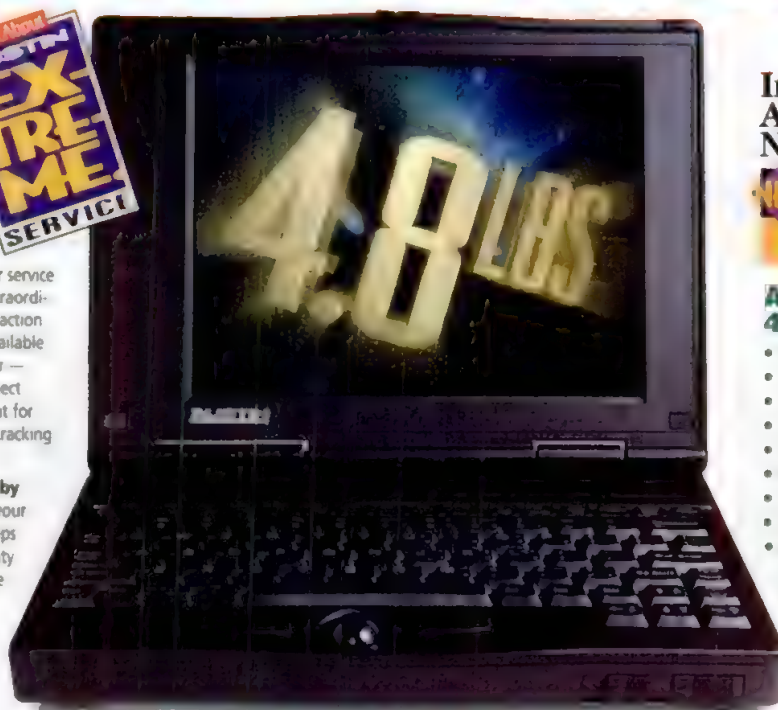
LiteSpeed Traveller



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- Weight with Battery: 6.3 lbs.
- Business Lease: \$132/mo.



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- 2 Type II or 1 Type III PCMCIA Slots
- Integrated Pointing Device
- EPP/EC Parallel, 16650 High Speed Serial, Keyboard, VGA Ports
- Business Audio, Voice Enabled
- Weight with Battery: 6.5 lbs.
- Business Lease: \$97/mo.

Austin Vista 486DX4-100 \$3,879

- 100MHz Intel 486DX4 Processor
- 10.4" TFT Active Color Display
- 8MB RAM (expandable to 28MB)
- 810MB Hard Drive
- Business Audio, Voice Enabled
- Weight with Battery: 6.5 lbs.
- Business Lease: \$139/mo.

Business Audio 486DX4-75 with Microsoft Office Standard 4.2 \$2,869

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- 9.5" DSTN Display
- 8MB RAM (expandable to 32MB)
- 810MB Hard Drive
- Business Audio, Voice Enabled
- Weight with Battery: 6.3 lbs.
- Microsoft Office 4.2 Preloaded
- Business Lease: \$109/mo.

Austin Vista 486DX4-100 with Microsoft Office Standard 4.2 \$3,169

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- 810MB Hard Drive
- Business Audio, Voice Enabled
- Weight with Battery: 6.5 lbs.
- Microsoft Office 4.2 Preloaded
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Circle 472 on reader service card

Cornell Computer Systems

PCI Power Workstation/P75 Ultima/P100

The \$2,295 Cornell PCI Power Workstation/P75 and the \$3,595 Cornell Ultima/P100 are targeted toward two very different markets: The 100-MHz Pentium unit, which supports both EISA and PCI expansion buses, is geared toward the high-performance needs of the networked business user. The 75-MHz Pentium system aims for the home PC market.

The 100-MHz system came housed in a tower case. Its motherboard has a Neptune chip set and contains a socket for a second processor. The 75-MHz Cornell system is a desktop unit that uses an ISA/PCI motherboard with an OPTi chip set. It did not, however, include any bundled application

above-average results, while the Tornado garnered an average score. Disk WinMark 95 scores were above average for the Tornado and average for the Dream Machine.—WPF
Comtrade,
City of Industry,
CA; 800-969-
2123, 818-961-

ble-speed CD-ROM drive and a 540MB hard disk, while the Ultima P100 had a quad-speed drive and a 1GB hard disk. Both Cornell systems also came with 15-inch ADI Micro-scan monitors.

On our Winstone 95 tests, the two Cornell units were average performers in their processor groups. Their Graphics WinMark 95 scores were also average, though their Disk WinMark 95 scores were below average.

Cornell backs these Pentium systems with a three-year parts-and-labor warranty and includes a year of on-site service.—WPF

Cornell Computer Systems, Walnut, CA;
800-886-7200, 909-594-5848; fax, 909-
594-9995.

Circle 473 on reader service card

Data Storage Marketing Inc.

DataStor NX5-80 DataStor NX5-100

Data Storage Marketing targets the home as well as business markets with the \$2,725 DataStor NX5-80 and the \$3,225 DataStor NX5-100. The NX5-80, which is based on an Nx586-P80 CPU, was one of the slowest machines we tested. The NX5-100, based on a 100-MHz Nx586, was an average performer for its processor class. Its scores on our benchmark tests made it competitive with systems based on 75-MHz Pentium CPUs but not with Pentium/100-based machines.

In contrast with the NX5-100's 1GB disk drive, the NX5-80 comes with a 504MB model. In all other aspects (except for their

CPU clock speed) these two systems are identical. Both have Alaris motherboards whose two VL-Bus slots hold a Promise disk-and-I/O controller and a Diamond Stealth 64 VL2+ graphics accelerator card.

Unlike some other NexGen systems in this roundup, however, the motherboards of these units are uncluttered with cables: The CPU socket and all the SIMM banks are accessible.

On our benchmark tests the NX5-80 posted average Graphics WinMark 95 scores for its processor class, but its other scores were

abysmal—largely because of an incompatibility with Windows' 32-bit disk driver. The Nx586-P100 posted average results.

Data Storage Marketing backs these systems with a three-year warranty on parts and labor.—WPF

Data Storage Marketing Inc., Boulder, CO;
800-543-6090, 303-442-4747; fax,
303-442-7985.

Circle 474 on reader service card

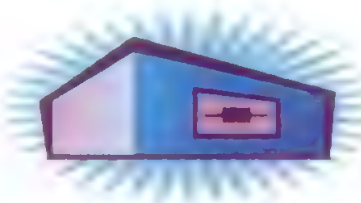
Dell Computer Corp

Dimension XPS P75 Dimension XPS P90 Dimension XPS P100 Dimension XPS P120c

Dell aims the Dimension line at the small or home office user who needs to be on the leading edge, and for the most part Dell has done a fine job of designing these systems to fit that market. Dell also markets the OptiPlex line for the corporate market.

The \$2,632 Dimension XPS P75 came with a 1GB hard disk. To that configuration the \$3,147 Dimension XPS P90 adds a 17-inch monitor and better graphics capability. Both units had above-average Disk WinMark 95 scores, though their Winstone 95 and Graphics WinMark 95 scores were average.

The \$3,547 Dimension XPS P100 packs more hardware and has better performance than the XPS P90; although it costs \$400 more, it is well worth considering. The



**The NX5-100 was competitive
with 75-MHz but not 100-MHz
Pentium systems.**



IN SHORT

Cornell's 100-MHz system is appealing, but the 75-MHz home-oriented unit is dull.



IN SHORT

The DataStor Nx586-based systems are relatively slow

Triton Pentium

ThunderBrick



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as ordinary 90MHz machines; our 120MHz Tritons have a Winstone95 rating of 197. Plus features like EDO memory,

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Dual channel PCI IDE supports up to four super fast 1.3 GB enhanced mode 3 & 4 hard disks. A quad speed CD-ROM and 3.5" floppy are standard, plus 2 serial & 1 EPP parallel port. Software includes DOS, Windows for Workgroups 3.11, plus askSam, DragonDictate, DAG, and Icon Heart.

Blazing Graphics

ThunderBricks™ feature ATI Mach64 PCI graphics cards or Radius Firestorm 192-bit adapter. The ATI provides the fastest 64-bit acceleration, and Firestorm is twice as fast with 192-bit performance and 1600x1200 by 16 Million color ability.

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ThunderBricks can be equipped with a wide variety of options to exactly match your needs. Our attractive packages for Networked Business, Multimedia, SOHO, CAD or DTP include the best accessories for each, plus they're pre-installed, ready-to-go and covered by the GE 4 Yr warranty.

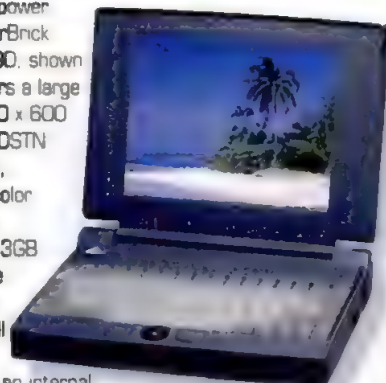
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Perhaps the most remarkable feature we include is DragonDictate Starter Edition, the new natural way to use a PC. Simply speak and your ThunderBrick responds. With DragonDictate, you can dictate words and numbers directly into your word processor, spreadsheet or virtually any Windows program. What's more you can also control Windows or any Win program function entirely by voice. Say fax it, and it does! Commanding your PC with voice is here, it works, its cool. DragonDictate alone is \$395, but we include it with any ThunderBrick, PowerBrick® or NoteBrick® if you mention this ad through August '95.

Take Your Power Too

Ergo also offers a complete line of high performance notebooks with fast Pentium or 486DX4 power

The PowerBrick Pentium 90, shown here, offers a large 10.4" 800 x 600 Active or DSTN color LCD, 65,000 color capability, up to a 1.3GB removable hard disk, two Type II PCMCIA slots plus an internal



14-14 Fax/Modem, stereo audio, all in 6 7lbs lbs a true desktop equivalent you can take with you.

ThunderBrick 120

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ThunderBrick 100

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ThunderBrick 75

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- 16MB EDO RAM, (128max)
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- 15" 28mm Color SVGA Monitor
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- WFW 3.11, DragonDictate and more
- Pentium ThunderBricks start at \$1,895

PowerBrick P90

\$3,895 Lease for \$155

- 90MHz Pentium
- 10.4" 800 x 600 DSTN Color LCD
- 810MB removable Hard Disk
- 16MB RAM (32max)
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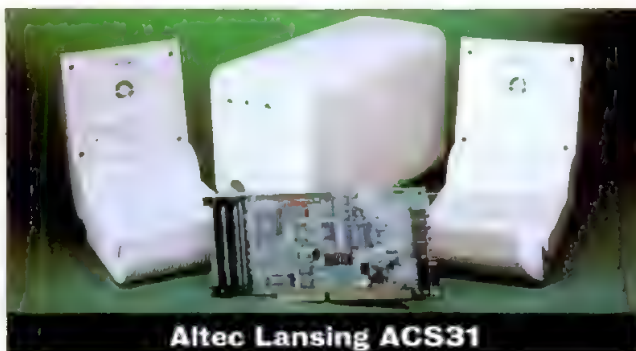
Picks and Pans

The new generation of Pentium and NexGen PCs has a lot to offer. Here are just a few noteworthy features:



MULTIMEDIA UPGRADES

If you're a serious multimedia user, you don't need to settle for the \$5 throwaway speakers that ship with most systems when you can get high-fidelity sound.



Altec Lansing ACS31



Poly 5751P



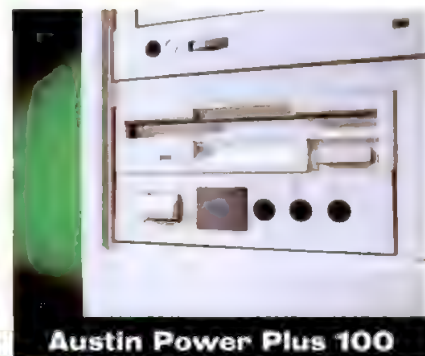
HUGE TOWER CASE Ten drive bays in one box might make sense in a server closet. But do you really need that many in a "desktop" PC?



Gateway P5-120



Intelesys Star 75



Austin Power Plus 100



QUAD-SPEED CD-ROM WITH THREE-CD CHANGER

Three-quarters of the machines we tested came with quad-speed CD-ROM drives. Gateway's new P5-120 ups the ante with a three-CD changer.



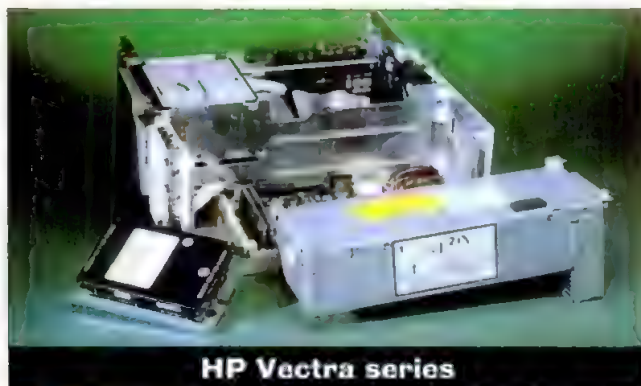
TECHNICAL-SUPPORT NUMBER

Ever need to call technical support, only to discover that you can't find the number? With the Intelesys Star 75, the number is posted right on the front of the system's case.



INFRARED PORT

You can easily transfer files from your notebook or print remotely using the Austin Power Plus 100's built-in infrared port. Watch for this to become increasingly popular in coming months.



HP Vectra series



BREAKAWAY CASE Servicing or upgrading the slimline HP Vectras is easy: just swing the internal components out of the way—no tools required.



Celebris XL 5100



9-FOOT MONITOR CORD A 9-foot monitor cord means that you can put your PC under your desk and still reach the monitor with the included cable—no extensions required.

Pentium and Nx586 PCs



IN SHORT

Dell's Dimension line offers high performance without sacrificing value.

SERVICE & RELIABILITY

Reliability	Above average
Repair service	Above average
Tech support	Above average

P100, except for its graphics card, a Nu-ber Nine Imagine 128 board with 4MB VRAM. This unit posted average to above average scores on all Windows-based tests.—WPF

Dell Computer Corp., 800-613-3355, 512-338-4400; fax, 800-727-8320.

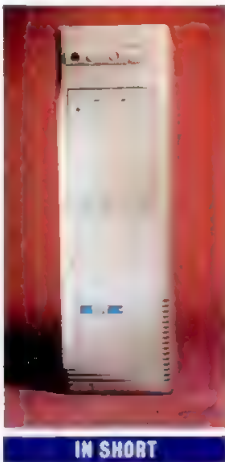
Circle 475 on reader service card

DFI

DFI Diamond P100

At \$3,399 the DFI Diamond P100 tower PC is aggressively priced, provides ample room for expansion, and offers average performance for a Pentium/100-based system. Mail-order vendor Diamond Flower (not to be confused with Diamond Technologies), positions this system as a high-performance business system as well as a full-featured home PC.

The DFI Diamond P100 was configured with a 1GB hard disk, a DFI 64-bit graphics

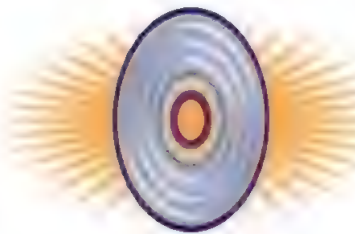


IN SHORT

An attractive price makes this otherwise pedestrian unit interesting.

ics accelerator board with 2MB of DRAM, and an Oak Technology Mozart-16 sound board. The combination of its quad-speed Mitsumi CD-ROM drive, 17-inch ADI MicroScan 5AP monitor, and external speakers make the system well-suited for high-resolution business presentation graphics as well as for home-oriented multimedia applications.

With its four vacant drive bays (one internal), the Diamond P100's tower case is



The Diamond P100 includes such extras as a quad-speed CD-ROM drive and a 17-inch monitor

com- and offers easy access to motherboard components. The unit's Intel Neptune-based motherboard has three PCI expansion slots and five ISA slots (one shared). Diamond Flower also offers a \$99 PCMCIA card reader for its system—a useful device if you share data often with your notebook PC.

The Diamond P100 fared reasonably well in our benchmark tests. All of its scores in our Windows-based tests fell comfortably into the average range for its processor group.

DFI backs its units with a two-year parts, life-time labor warranty and offers an optional one-year on-site service policy.—Robert Anthony

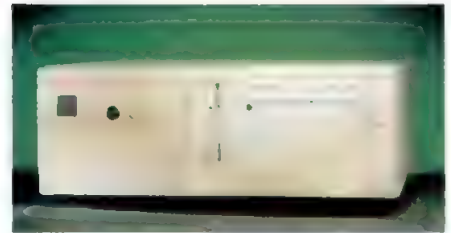
DFI, Sacramento, CA; 800-808-4334, 916-568-1234; fax, 916-568-1233.

Circle 476 on reader service card

Diamond Technologies Inc.

Thunder Power Pentium Power Server

For the budget-conscious, Diamond Technologies offers the \$2,595 75-MHz Pentium-based Diamond Thunder Power desktop PC and the \$2,995 Pentium/100-based Pentium Power Server—a mini-tower PC that,



IN SHORT

Diamond's machines are average performers with attractive prices.

despite its name, is sold both as a server and as a workstation. On our benchmark tests, both machines were mainly average performers.

Diamond Technologies sells its PCs both direct and through resellers (the prices quoted above are estimated street prices). Its Thunder Power model, which came with a 539MB hard disk, also has an ATI 64-bit graphics card with an unusually large 4MB of VRAM. The Pentium Power Server came with a 1GB hard disk and an ATI 64-bit graphics card with 2MB of DRAM.

Both machines included a double-speed CD-ROM drive, a 15-inch Impression monitor, and a 16-bit Diamond Technologies sound card. Both systems also had the same motherboard, which carried a SIS chip set and offered four ISA and four PCI expansion slots (one shared).

Both Diamond machines logged average scores on most of our Windows-based tests. The exception was the Power Server's below-average Graphics WinMark 95 score, a consequence of a relatively slow CPU-memory subsystem.

Diamond Technologies backs its systems with a three-year warranty on parts and labor.—RSA

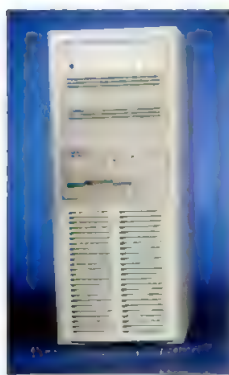
Diamond Technologies Inc., Anaheim, CA; 800-989-7253; 714-533-9910; fax, 714-533-7805.

Circle 477 on reader service card

Digital Equipment Corp.

Celebris XL 5100 Celebris 575

Digital Equipment Corp.'s high-end business systems, the Celebris XL 5100 and Celebris 575, combine good engineering with average performance across the board. Unfortunately, Digital's prices for the Pentium/75-based 575 (\$4,021) and the Pentium/100-based XL 5100 (\$4,497) are higher than those

**IN SHORT**

Digital's machines perform well but are relatively expensive.

SERVICE & RELIABILITY

Reliability	Above average
Repair service	Above average
Tech support	Above average

can swap this board for an Alpha processor board for \$2,995. The XL 5100's motherboard integrates I/O and SCSI ports, leaving four open expansion slots. The system also includes a 1GB hard disk and triple-speed CD-ROM drive.

The 575's interior is cramped. Removal of the unit's cover, easily accomplished by turning two keys on either side of its slimline case, reveals a motherboard with integrated I/O and 64-bit S3 video circuitry. Still, only one PCI/ISA slot is available. The 540MB hard disk, double-speed CD-ROM and floppy disk drives fill all the bays.

Both PCs came with a 17-inch monitor and included Digital's tutorial and configuration software.—RSA

Digital Equipment Corp., Maynard, MA; 800-722-9332, 508-264-7111; fax, 800-524-5694.

Circle 478 on reader service card

DTK Computer Inc.

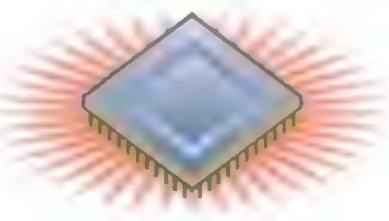
QUIN-35 QUIN-52

Though the components in the 100-MHz Pentium DTK QUIN-52 (\$3,650 street price) and the 75-MHz Pentium DTK QUIN-35 (\$2,250 street price) from DTK Computer seem to hold promise, it was not borne out on our benchmark tests.

Both PCs packed impressive components: 1.2GB hard disks, quad-speed

CD-ROM drives, Cirrus Logic graphics cards with 2MB of VRAM, and Sound Blaster 16 cards. The QUIN-52's EISA/PCI motherboard holds up to 512MB of RAM and has a second CPU socket—a set of features that makes it seem more like a small server than a desktop PC. Despite all this, both units performed poorly.

The QUIN-52 had below-average Winstone 95, Graphics WinMark 95, and Disk WinMark 95 scores. The PCI/ISA-based QUIN-35 was the worst performer—by wide margins—across our



The QUIN-35 had a slow memory subsystem that caused poor performance on the whole.

Windows-based tests. It even had an abysmal score on our CPUmark₁₆ tests, where variance between PCs with the same CPU is unusual. The culprit: a very slow memory subsystem.

Both PCs' performance suffered partly because they came loaded with Microsoft Windows 3.1 instead of Microsoft Windows for Workgroups 3.11, which would have allowed them to benefit from WfWG's 32-bit file-access feature.—RSA

DTK Computer Inc., City of Industry, CA; 800-289-2385, 818-810-8880; fax, 818-810-0090.

Circle 479 on reader service card

**IN SHORT**

The DTK systems have impressive components but poor performance.

SERVICE & RELIABILITY

Reliability	Average
Repair service	Average
Technical support	Average

Duracom Computer Systems Inc.

MiniPro Nx586-100

Duracom markets its NexGen systems as a value line—but if there is an argument to be made for choosing a NexGen Nx586-P100-based PC over one based on a Pentium chip, the \$3,599 (\$3,099 street price) Duracom MiniPro Nx586-100 didn't make it. The MiniPro's price is comparable with that of many Pentium/100 units in this roundup, but its performance was barely a match for that of Pentium/75 systems. Duracom also sells comparably configured Pentium-based units for \$200 to \$500 more; the company's PCs are custom-configured and marketed to mainstream users.

The midtower MiniPro offers a respectable array of components, including a quad-speed CD-ROM drive, a set of Jazz Hipster stereo speakers, and a 15-inch ADI monitor. Like the other NexGen-based units in this roundup, the MiniPro's Alaris motherboard did not include integrated I/O ports. This resulted in a crowded interior. The unit's two VL-Bus slots contained a BusLogic SCSI controller and a Number Nine GXE64 64-bit graphics card with 2MB of DRAM in the unit's two VL-Bus slots. Two of its five ISA slots were occupied by a multifunction I/O board and a Sound Galaxy WaveRider 32+ 16-bit wavetable-synthesis sound board.

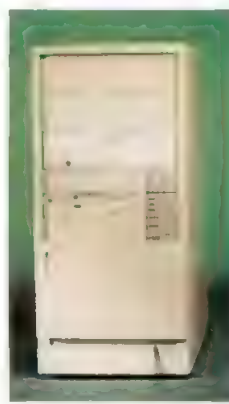
Of the seven Nx586-P100-based PCs in this roundup, the MiniPro yielded the lowest Disk WinMark 95 score; the poor disk performance dragged down its Winstone 95 score as well. Its Graphics WinMark 95 score was average for Nx586-P100 machines.—RSA

Duracom Computer Systems Inc., Irving, TX; 800-551-9000, 214-518-1200; fax, 214-518-1090.

Circle 480 on reader service card

IN SHORT

Duracom includes high-end multimedia features; performance was disappointing.





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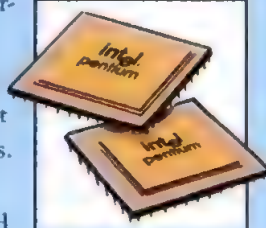
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Ergo Computing Inc.

ThunderBrick 100+

Multimedia aficionados will appreciate the hardware and software bundle that comes with Ergo Computing's first desktop: the \$4,295 Ergo ThunderBrick 100+. The 100-MHz Pentium system, named after the Brick portable products for which Ergo is known, was an average performer that came with numerous communications and multimedia extras plus an outstanding warranty.

The tested ThunderBrick 100+ included a Media Magic Telemetry-32 19.2/14.4-Kbps voice/fax modem and wavetable audio board, as well as a Cambridge Soundworks stereo speaker system, which includes a hefty amplifier/subwoofer unit (both speakers and modem are usually \$200 options).

Preinstalled on the hard disk were OAG FlightDisk travel software (a full-fledged, not a trial, edition, although the included data is limited to three months), Synchro Development Corp.'s Multimedia Connect communications software, Verbex continuous speech-recognition software, and other multimedia utilities.

The unit came equipped with a 1GB hard disk, a Toshiba quad-speed CD-ROM drive, a Diamond Stealth 64-bit graphics card with 4MB of VRAM, and a 17-inch monitor. It uses a Triton motherboard.

The system was an average performer on all of our Windows-based benchmark tests. Ergo Computing offers a four-year parts-and-labor warranty with four years of on-site service. The company also provides 24-hour, 7-day telephone support.—*RSA Ergo Computing Inc., Peabody, MA; 800-633-1925, 508-535-7510; fax, 508-535-7512.*

Circle 481 on reader service card

**IN SHORT**

The ThunderBrick is an average performer with attractive multimedia extras.

Everex Systems Inc.

**Step SP/75
Step SP/100**

The \$3,479 Everex Step SP/75 (Pentium/75) and the \$3,899 Everex Step SP/100 (Pentium/100) were run-of-the-mill systems. Everex—now owned by First International Computer—targets business users with these PCs, which are sold both through resellers and retailers.

Both PCs use identical mini-tower cases and Neptune motherboards, as well as many of the same components. Both systems had First International 64-bit graphics cards with 1MB of DRAM, quad-speed CD-ROM drives with proprietary ISA interface cards, and 16-bit sound boards.

The main differences between the PCs were in storage and monitor size. The Step SP/100 came with a 1.2GB hard disk and a 17-inch monitor, whereas the Step SP/75 came with a 540MB hard disk and a 15-inch monitor. Because Everex did not configure the Step SP/75 to use Enhanced IDE's Logical Block Addressing scheme, however, only 472MB of drive space was actually usable in the tested configuration.

The Step SP/75 was an average performer on all of our Windows-based benchmark tests. The Step SP/100 had an average Disk WinMark 95 score but below-average scores on our Winstone 95 and Graphics WinMark 95 tests. The systems' graphics cards were First International Computers Trio64 models, based on S3's Trio64 chip set.

Everex provides a three-year warranty with one year of on-site service.—*RSA Everex Systems Inc., Fremont, CA; 800-383-7391, 510-498-1111; fax, 510-683-2186.*

Circle 482 on reader service card

**IN SHORT**

The Everex machines are average performers with moderate expansion room.

SERVICE & RELIABILITY

Reliability	Average
Repair service	Average
Tech support	Below average

Gateway 2000 Inc.

**Gateway P5-75
Gateway P5-100XL
Gateway P5-120**

With Gateway 2000's \$4,299 P5-120, \$3,340 P5-100XL (both Editors' Choices), and \$2,658 P5-75, you get top Windows performance and quality components at extremely aggressive prices.

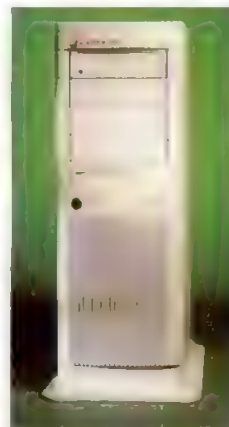
These PCs are part of Gateway's Professional Systems line. Its Family PCs come with modems and home-oriented software. The Pentium/75 P5-75 is aimed at budget-conscious business users, whereas the Pentium/100 P5-100XL and Pentium/120 P5-120 are for power users.

All systems came with quad-speed CD-ROM drives, and the P5-120's drive featured a three-CD changer (\$100 option). Each also had a 16-bit wavetable sound card. The P5-120 and P5-100XL came with Altec Lansing speakers and subwoofer; the P5-120 also adds a 14.4-Kbps voice modem and a 17-inch monitor.

The P5-100XL and P5-120—powered by Triton chip sets and EDO DRAM—were outstanding Windows performers, posting the top Winstone 95 scores in their respective CPU classes. On our Graphics WinMark 95 tests, the P5-100XL earned an above-average score, but it had only average results on the Disk WinMark 95 tests; the P5-120 posted average scores on these tests. The Neptune-based P5-75's test scores were all average.—*RSA*

Gateway 2000 Inc., North Sioux City, SD; 800-846-2000, 605-232-2000; fax, 605-232-2023.

Circle 483 on reader service card

**IN SHORT**

Gateway's P5-100XL and P5-120 are best-of-breed systems; the P5-75 is a good buy.

SERVICE & RELIABILITY

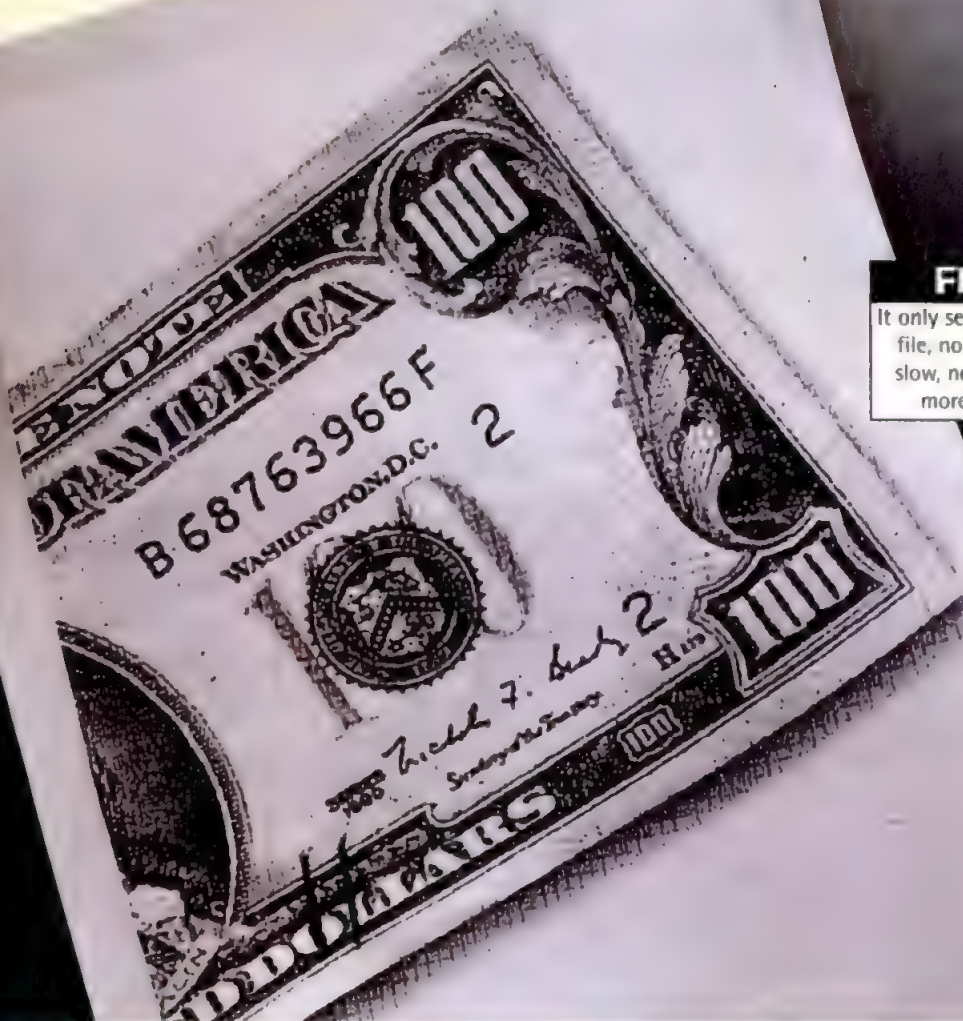
Reliability	Above average
Repair service	Above average
Tech support	Above average

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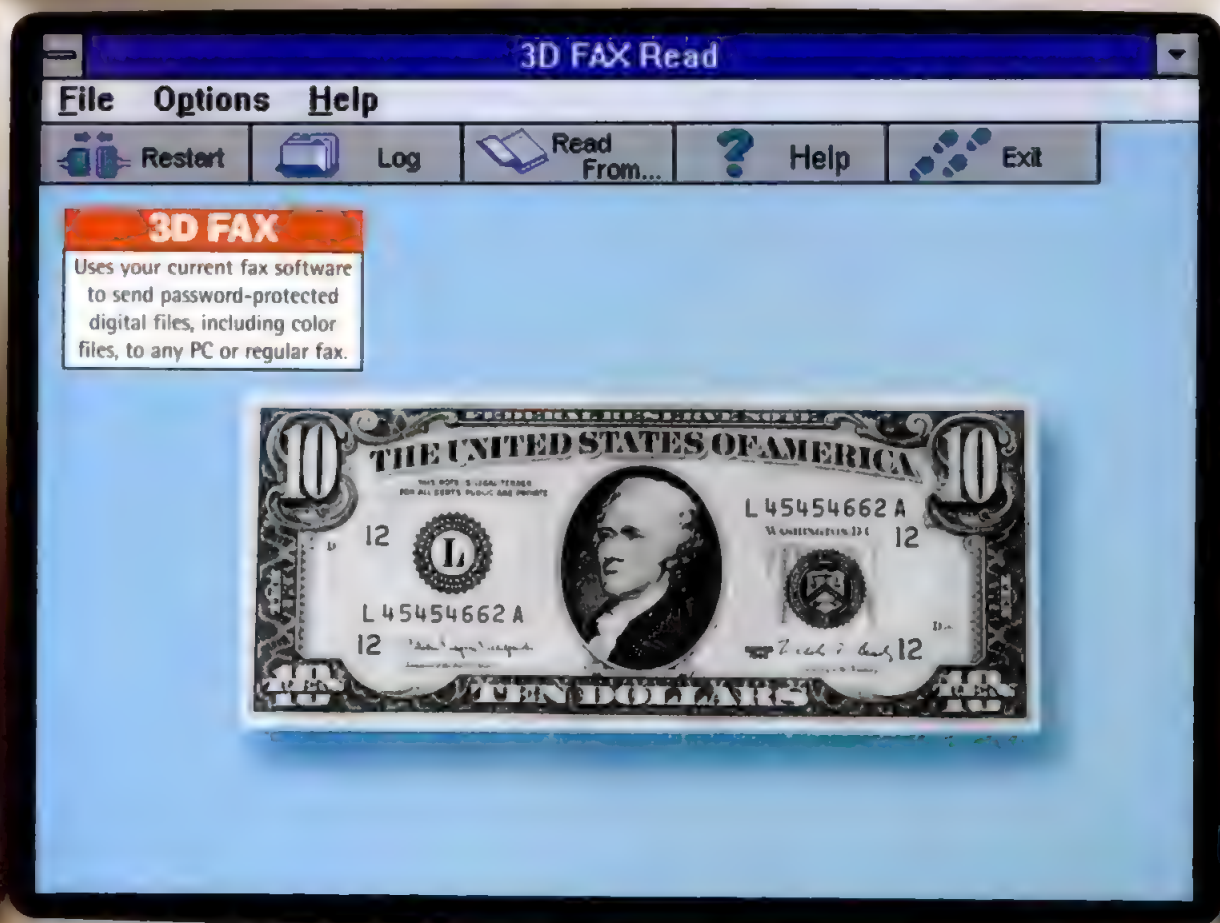
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CIRCLE 016 ON READER SERVICE CARD

Benchmark Tests: Pentium and Nx586 PCs

Pentium/120 systems average about 20 percent faster than Pentium/100s, although they are only about 10 percent faster than typical 100-MHz machines that use Intel's new Triton chip set. The best Pentium/75 machines outperform many Pentium/100 PCs. Systems based on NexGen Nx586 CPUs can't match the performance of comparable Pentium units.

What the Numbers Mean

If you need the ultimate in speed, you can find it in a Pentium/120 system—if you look carefully. On our Winstone 95 tests, which measure overall system performance under Windows, the fastest 120-MHz Pentium machines easily broke records held by 100-MHz systems. But some Pentium/120 machines couldn't boast such impressive results: The HP Vectra VL 5/120, for example, scored only 141—lower than the *average* score for a Pentium/100 system, which was 152. The culprits: a VLSI chip set, a write-through L2 cache, and a slow Cirrus Logic graphics accelerator. The moral: A speedy CPU can be hobbled by slow supporting components.

Nx586-based systems were also disappointing performers. NexGen claims that the performance of systems based on its 93-MHz processor, the fastest currently available, matches that of Pentium/100 machines. (This underlies the company's reasoning for naming the chip the Nx586-P100.) But in this roundup, NexGen didn't hit the target. The fastest Nx586-P100 system, with a Winstone score of 134, was eclipsed by the average Pentium/100 PC. Nx586-P100 machines compared more closely with Pentium/75 and Pentium/90 systems. And systems based on the Nx586-P80, which runs at 75 MHz, fared worse than many of the Pentium/60 machines we've previously tested.

Most of the Pentium systems in this roundup were based on Intel's Neptune chip set, which has dominated PC motherboards since the introduction of the 3.3-volt, 90-MHz Pentium processor. But just as we were acquiring the last products for this story, Intel released its Triton chip set, which is both cheaper and faster than the Neptune chip set. Triton supports an enhanced PCI burst mode that allows data transfers at rates exceeding 100 MBps and a new Mode 4 Enhanced IDE transfer mode that allows faster data transfer to and from hard disks that support it. Triton also lets

system manufacturers use EDO DRAM and pipelined-burst caches. EDO DRAM is a slightly modified form of fast-page mode DRAM that lets memory cycles occur more quickly; the Winstone scores of machines with EDO DRAM averaged about 20 percent higher than scores garnered by units using standard DRAM, although some of that improvement is attributable to factors other than the DRAM. Pipelined-burst cache provides no apparent benefit in today's implementations, although as CPU bus speeds climb to 75 MHz and beyond its benefits will become apparent.

On the whole, Triton-based systems turned in Winstone scores that averaged 13 percent higher than the scores posted by Neptune-based machines. In coming months, you can expect virtually all system manufacturers to make the transition to Triton. New chip sets from other manufacturers, such as OPTi, SIS, and VLSI, will support similar capabilities too.

GRAPHICS WINMARK 95

The 120-MHz Pentium processor also helped push Graphics WinMark 95 scores to new heights: For the first time, we saw a PC score over 20 million pixels per second. The new record goes to the Micron P120 Millennia, which uses a Diamond Stealth 64

card based on S3's Vision 964 chip. Boards based on the Vision 964 and the newer S3 Vision 968 accelerator were the top performers at virtually every CPU level. Close behind the S3-based boards were boards with ATI Technologies' Mach 64 chip and Matrox Electronic Systems' MGA graphics engine.

The slowest graphics boards in this roundup were those based on the Cirrus Logic CL-GD5434 chip. Systems with Cirrus Logic boards scored about 20 percent lower on the average than systems with boards by other vendors.

DISK WINMARK 95

Disk WinMark 95 scores show a clear victory for Enhanced IDE hard disks paired with Microsoft Windows for Workgroups 3.11. Windows for Workgroups 3.11 offers a 32-bit file cache that's not available in Windows 3.1x. This 32-bit file cache, when properly implemented with the PCI IDE disk driver, provides a significant boost in disk performance beyond what SmartDrive alone adds.

Two machines, the Polywell Poly 5100D2 and the Micro Express MicroFLEX-PCI/P75, came with caching disk controllers. The extra hardware cache adds nothing to performance for typical desktop applications; SmartDrive with file cache remains the most effective caching solution for PCs running Windows.

SCSI hard disks, present in only nine of the machines we tested, were lackluster performers in comparison with the Enhanced IDE speedsters.

The fastest Nx586-P100 system was easily eclipsed by the average 100-MHz Pentium PC.

CPUMARK₁₆

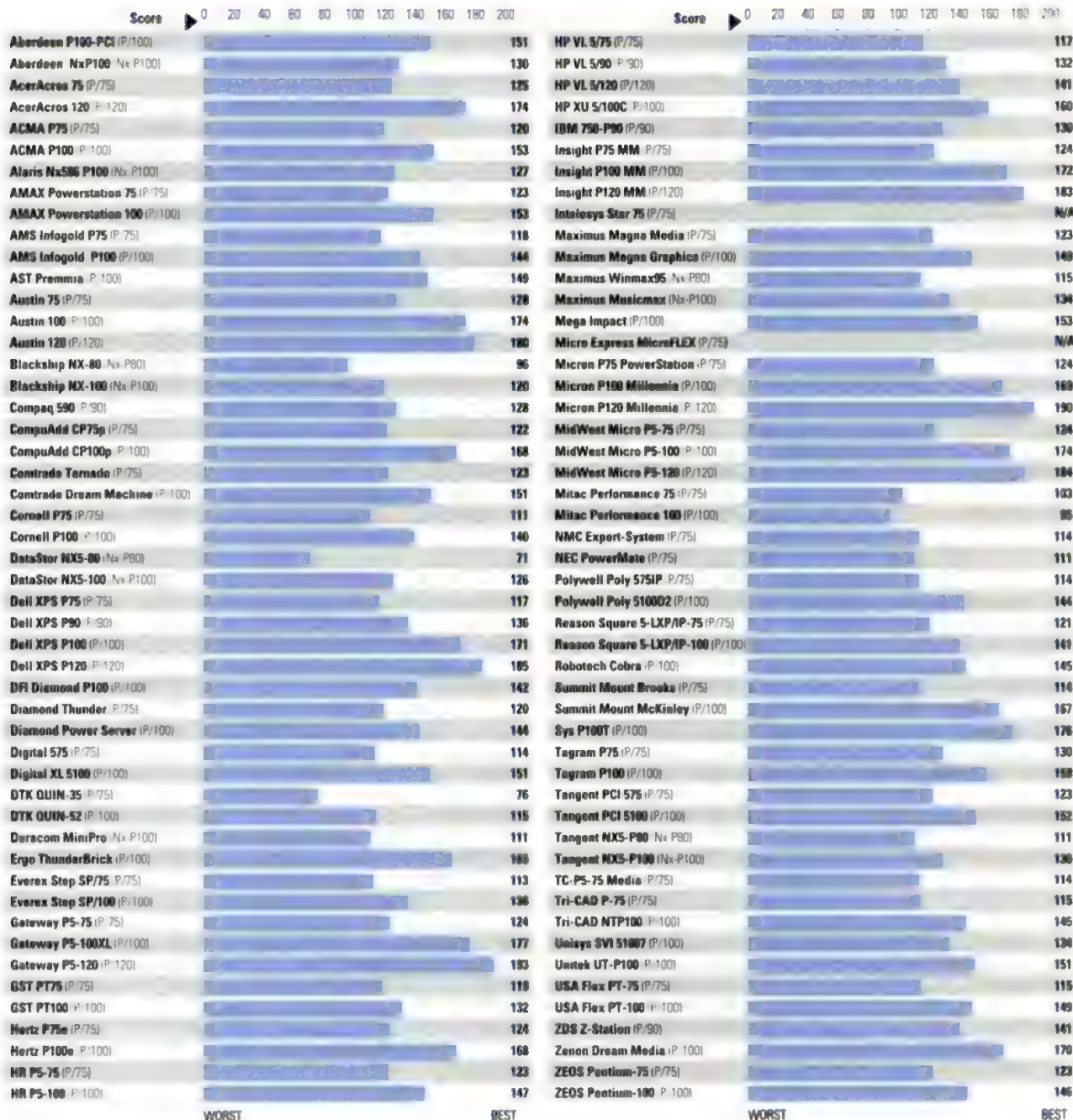
The impact of a fast CPU is most evident on the CPUmark₁₆ tests, which exercise the processor, cache, and system memory. Pentium/120 systems stole the show: All but one of them (the HP VL 5/120) used EDO DRAM, which helps to minimize memory wait states that slow down the processor.

Among Pentium/100-based systems were machines with and without EDO DRAM. Our results showed that EDO

DRAM ensures a CPUmark₁₆ performance boost of about 7 percent.

Among the Pentium/100s, the highest-scoring Neptune-based machines were the AST Premmia GX P/100 and HP Vectra XU 5/100C, each of which use 512K of L2 cache. This compares with other PCs' 256K.

The effect of cache was similar in 75-MHz systems. The first-place Tagram Thunderbolt P75 had 1MB of L2 cache,

WINSTONE 95

N/A—Not applicable. The product could not perform this test.



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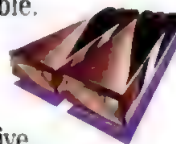
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CIRCLE 353 ON READER SERVICE CARD

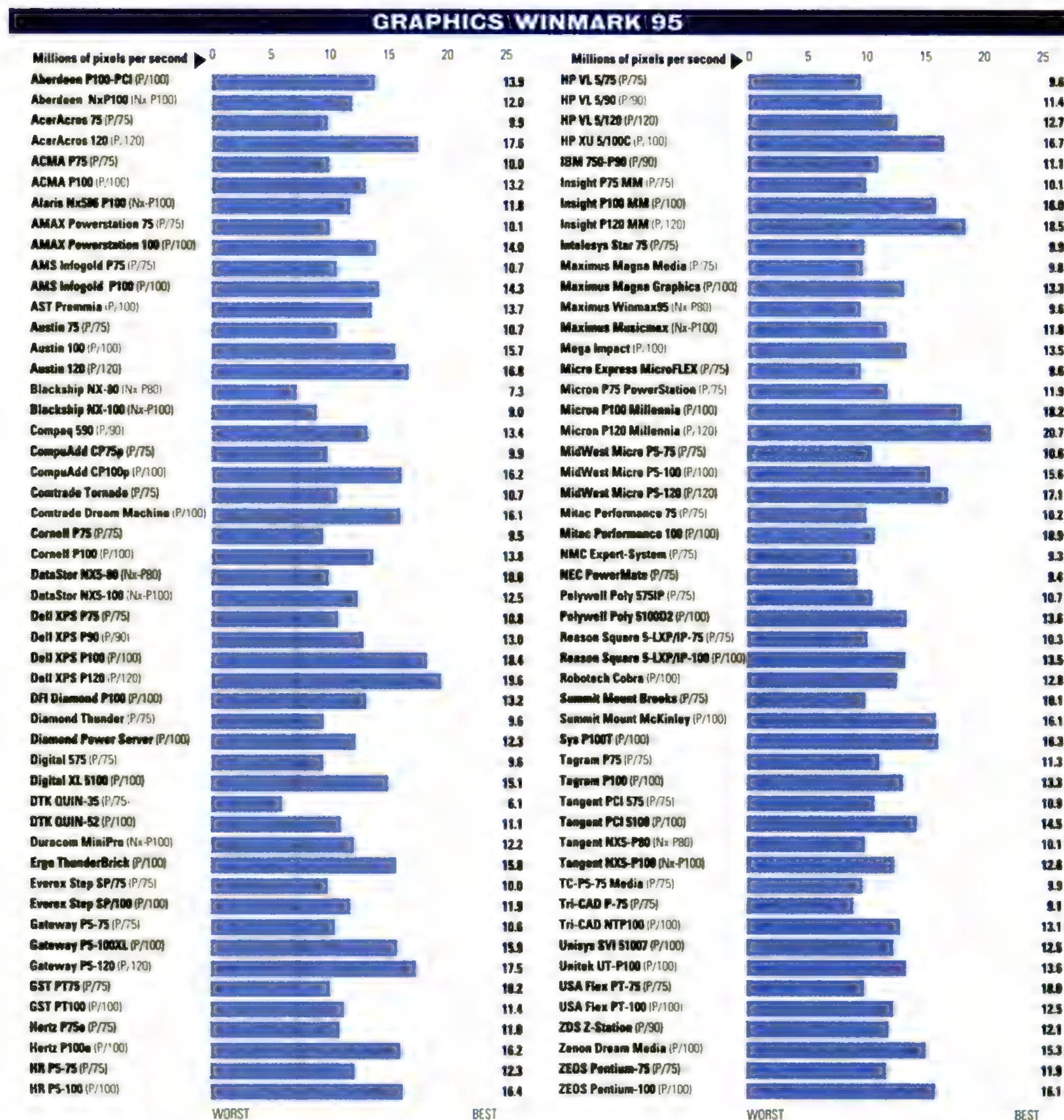
Benchmark Tests: Pentium and Nx586 PCs

and the second-place Hertz P75e had 512K of L2 cache. At the opposite end of the spectrum, the DTK QUIN-35 had problems with its L1 and L2 cache subsystems; its CPUmark₁₆ score was well below the level we would expect for a 75-MHz CPU. In fact, it was dead last among the systems we tested.

The Nx586 CPU uses a different cache-subsystem design than the Pentium does. NexGen integrates the L2 cache controller onto the CPU itself and places the L2 cache on a separate

bus that runs at the full processor speed. The Nx586 processors, however, could not match their Intel counterparts on the CPUmark₁₆ tests. The Nx586-P80 machines averaged about 20 percent lower than Pentium/75 systems, while the Nx586-P100 systems lagged Pentium/100 machines by almost 40 percent.

NexGen's first-generation proprietary chip set will undoubtedly improve in successive iterations. Aside from the poor memory subsystem performance and lack of support for EDO DRAM, the chip set also supports only VL-Bus for



high-speed data transfers, at a time when PCI is becoming a de facto standard.

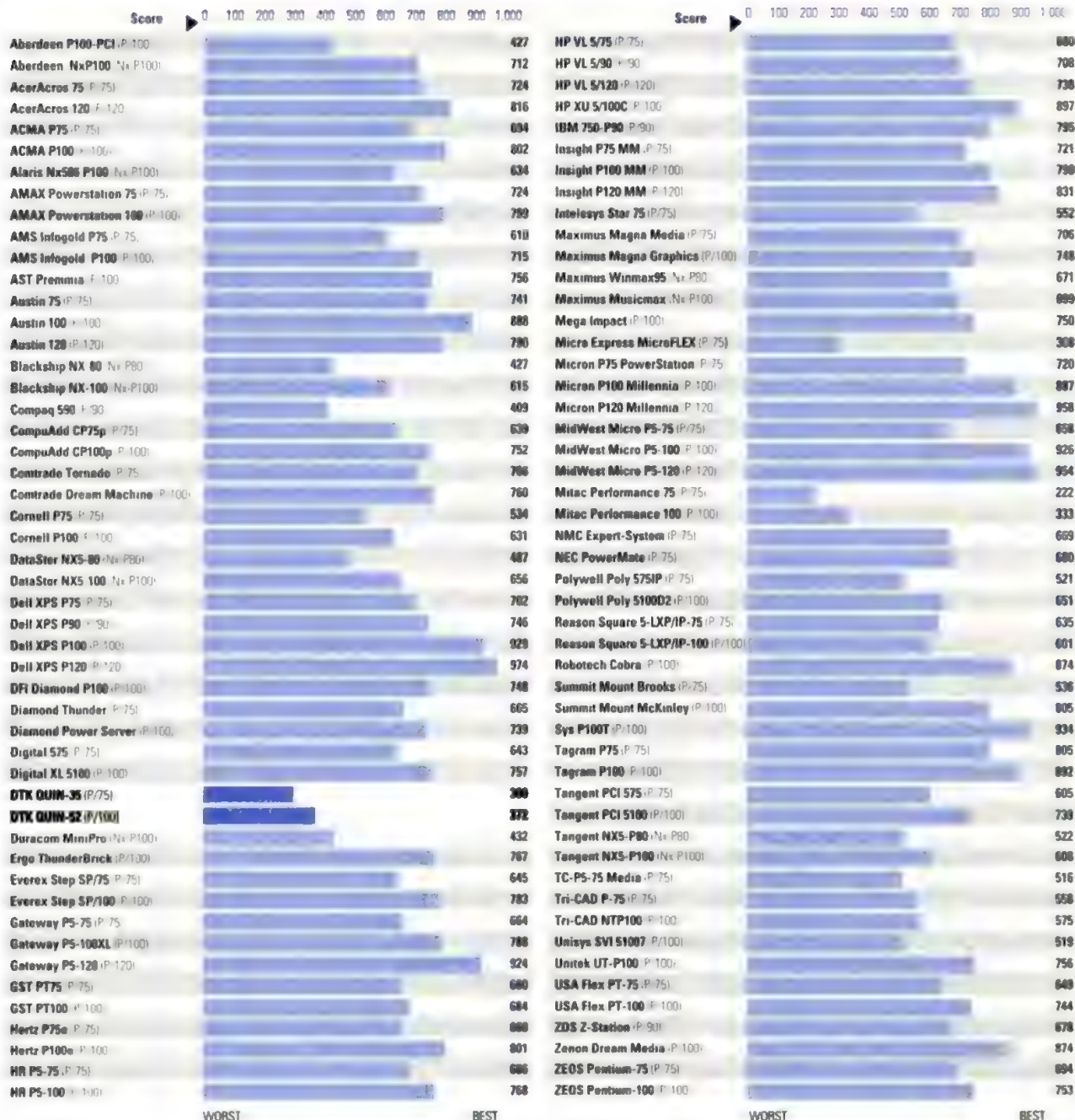
DOS TESTS

Any system here will provide adequate performance under DOS. The only notable result was the poor showing on our DOS Video tests of units that use Matrox's MGA cards and Number Nine Imagine 128 cards. Such poor performance will have a perceptible effect on some graphical DOS-based games.

How We Tested

All machines were tested with 16MB of RAM. We enabled SMARTDRV.EXE in write-back mode with a cache size of 4MB; on systems running Microsoft Windows for Workgroups, we set up a 32-bit file cache of 4MB and allowed Windows to shrink the SmartDrive cache to 128K. We standardized on a 20MB permanent swap file and defragmented the hard disk. We used each vendor's graphics driver for 800-by-600 resolution with 256 colors, small fonts, and a vertical refresh rate of 72 Hz. We disabled power management features and removed any unnecessary drivers.

DISK WINMARK 95



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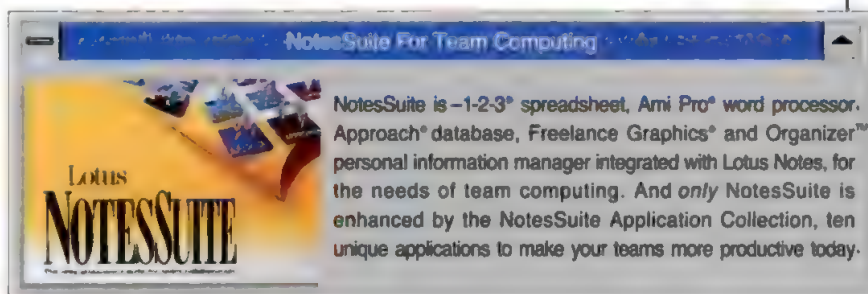
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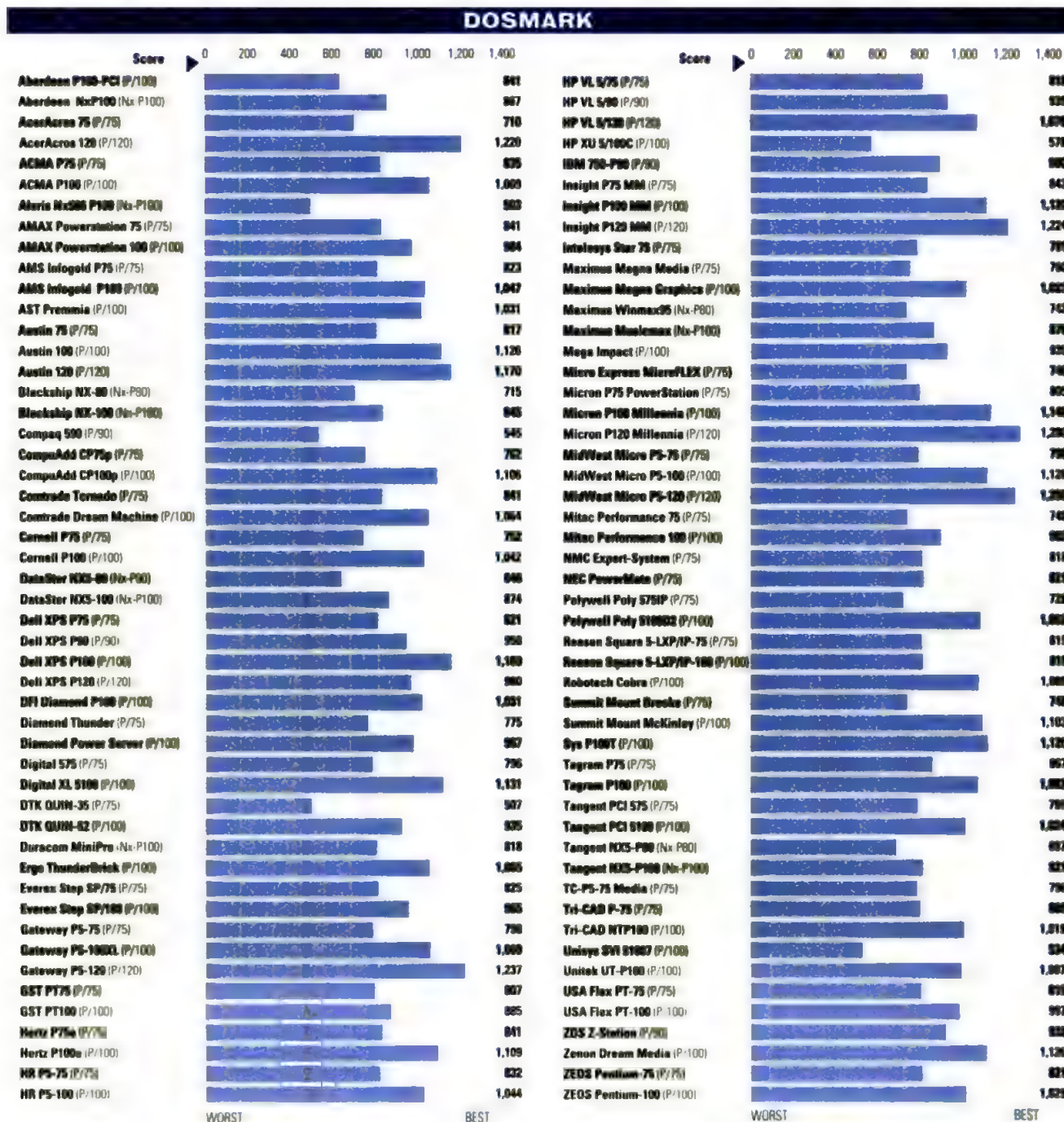
We used our benchmark test suite Winstone 95, Version 1.0, to measure the machines' performance when running typical Windows applications. Winstone 95 measures the time a PC takes to execute a set of scripts that exercise 13 of the best-selling Windows 3.1 applications. Winstone weights a given PC's test timings based on the applications' unit market shares; it derives a composite number and converts it to a relative score (relative to the performance of a 386DX/25 Compaq Deskpro/M with 4MB of RAM, whose score is defined as 10).

We also present separate Winstone scores for four categories of applica-

tions: Spreadsheet, Word Processing, Database, and Business Graphics/Desktop Publishing. Each of these scores is relative to the Compaq Deskpro/M, whose score is defined as 1.

We used WinBench 95 to measure the performance of each machine's graphics subsystem under Windows, generating the Graphics WinMark 95 score, which we report in millions of pixels per second. We also used WinBench to determine the Disk WinMark 95 score, a measure of disk subsystem performance under Windows.

We used PC Bench 9.0 as a measure of processor, video, and disk perfor-



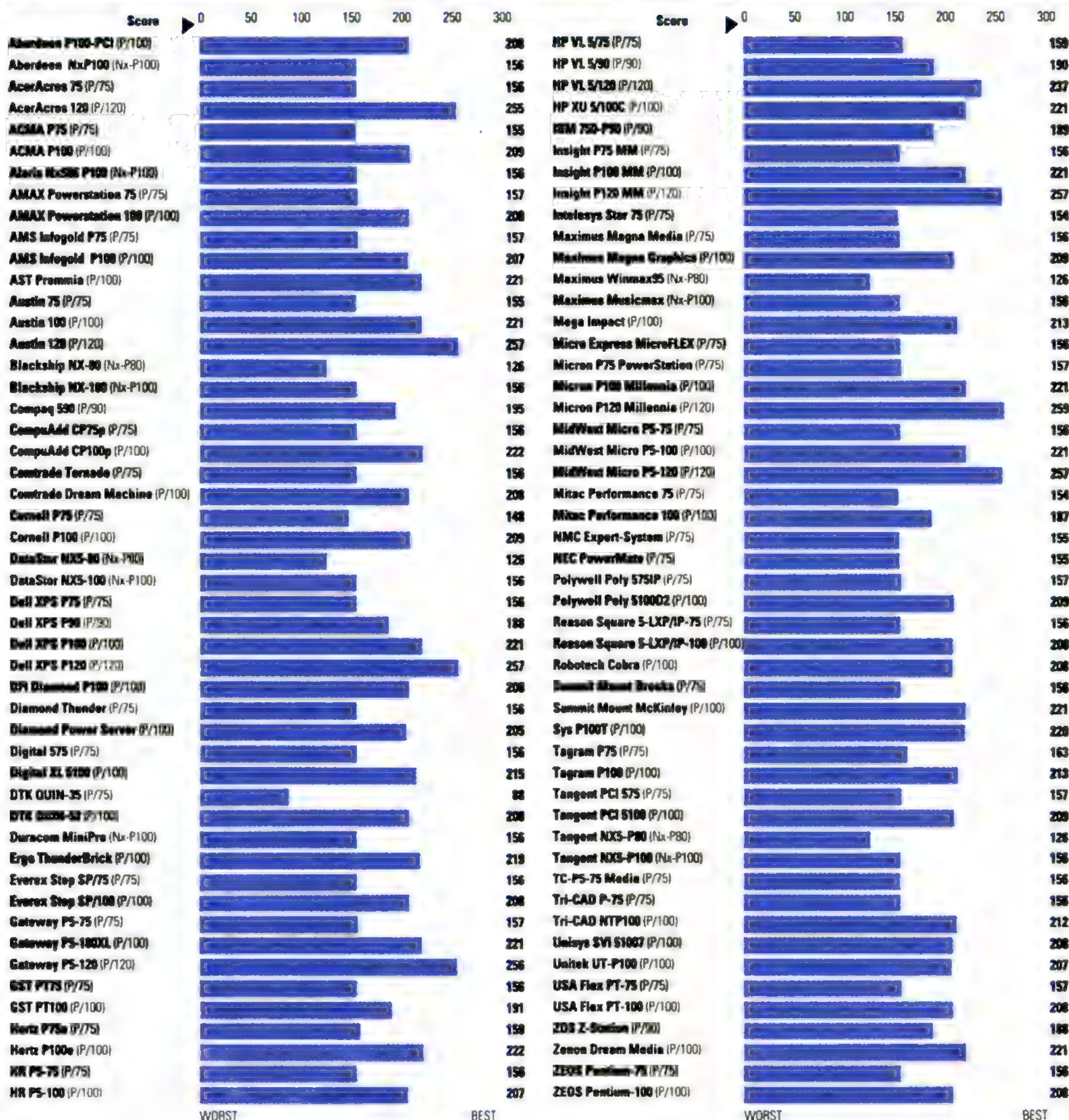
mance under DOS applications. The CPUmark₁₆ score indicates the speed of a PC's processor subsystem, including the CPU, cache, and system RAM. The DOS Video score indicates the speed of VGA operations involving both text and graphics. The DOS Disk score reflects the performance of a PC's disk subsystem under DOS. The DOSMark score is a composite of those three results and approximates overall system performance under DOS.

Microsoft Corp. granted us permission to use VidTest—a tool for testing digital-video performance—to gauge the quality of multimedia playback. We used VidTest to determine CD-ROM Maximum Throughput, a drive's best-case

data-transfer rate in kilobytes per second. VidTest also let us measure CD-ROM CPU Utilization, the percentage of the processor's bandwidth occupied by servicing the CD-ROM subsystem at a 300-Kbps transfer rate in 16K blocks. We also used VidTest to determine the number of video frames dropped during playback of an AVI file encoded at 160-by-120 resolution, 8-bit color, and 15 frames per second.

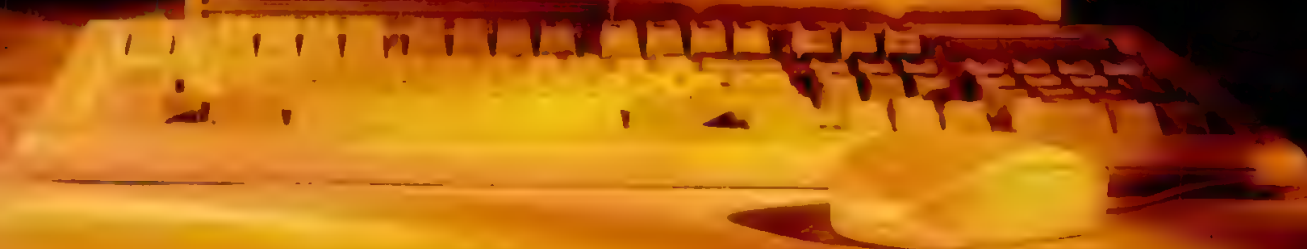
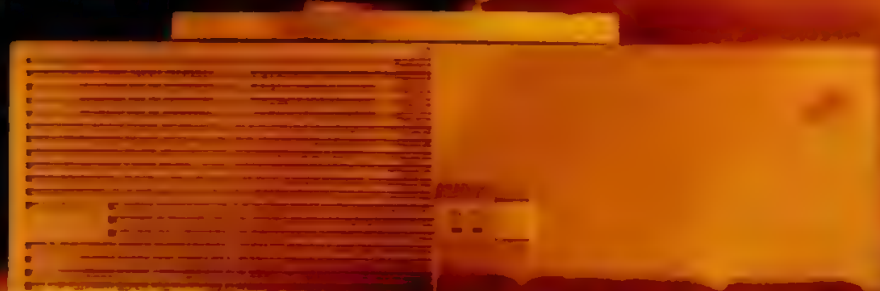
We generated CD-ROM Database Search results by timing each machine as it performed a complex full-text search of the Ziff-Davis Computer Select CD-ROM.

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and 57 minutes searching for a new computer.*

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- A SpaceSaver configuration with 3 slots, 3 bays

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IBM PC 300:

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- 1MB video memory
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- IBM basic 101-key keyboard and mouse
- Plug and play enabled
- Energy Star Compliant
- PCMCIA enabled
- DOS, Windows and IBM EasyTools
- The HelpWare 3-year warranty includes: 1-year onsite service* 30-day money-back guarantee††

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The IBM PC Server 300 is designed and built to deliver better real-world file server performance while costing you less.

In fact, the PC Server 300 with the 60MHz Pentium™ processor bested the equivalently configured Compaq® ProLiant 1000 5/60, achieving up to **40% greater throughput**. (Test results based on CLARE—Comprehensive LAN Application-performance Report Engine. Test conducted using NetWare® under real-world conditions.)*

For a complete networking solution, ask about our NET Select™ service featuring IBM PC Servers, IBM clients, networking software and more. We're ready to help with a custom solution that's CustomerFit to your business needs.

Our enhanced throughput is the result of thoughtful design features like PCI local bus, standard 256KB Level-2 Write-Back Cache, and our IBM SCSI-2 Fast PCI-Bus Adapter (standard on models with Pentium processors, available with all models). The result: **more productivity now.**

You can't beat the 3-year limited warranty.³ **3 years of onsite service** are included.⁴ And so are parts and labor for the full 3 years of coverage. That's a big money saver!

You can count on HelpWare® toll-free voice support, 24 hours a day, 7 days a week.⁵ We also offer 24-hour bulletin board and automated fax support.

The flexibility built into your Server will **save you money**. We've tested it with the most popular LAN add-ons and peripherals including CD-ROMs and tape backups, monitors, printers and plotters, and Ethernet[®] and Token-Ring adapters.



The IBM PC Server is available in DX2/66MHz and P60 Pentium models. Pick the one that's perfect for your business.

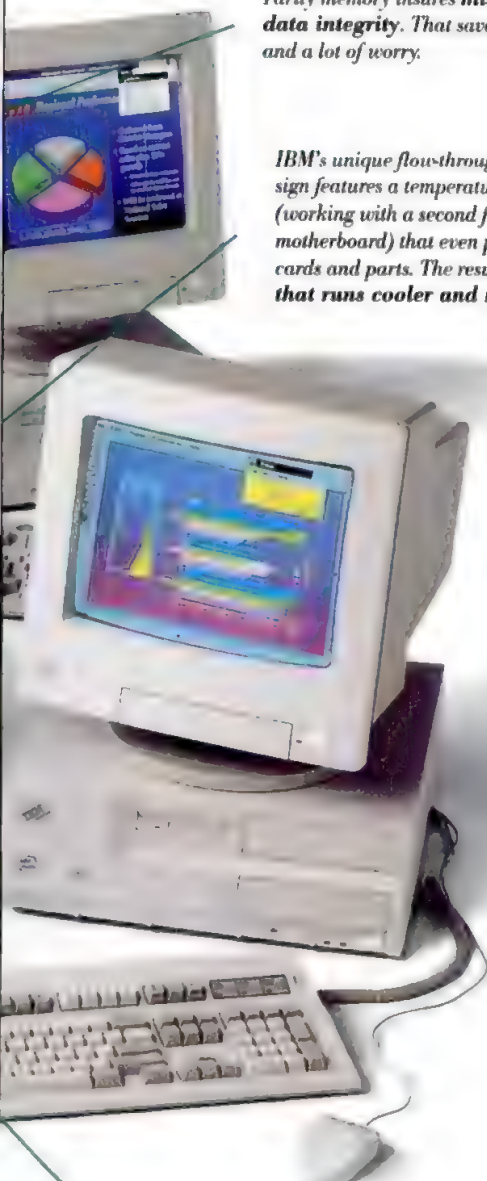


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world performance that the competition.

Parity memory insures **mission-critical data integrity**. That saves you money—and a lot of worry.

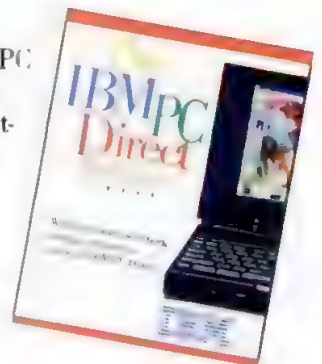
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HelpWare Service and Support - Both models come with 30-day money-back guarantee³ - Both models come with 3-year onsite limited warranty⁴	
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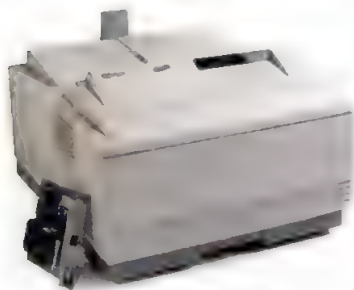
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	DOS		WINSTONE 95				CD-ROM			
	Video	Disk	Spread-sheet	Word Processing	Database	Business Graphics/DTP	Maximum Throughput (KBps)	CPU Utilization (percent)	Video Frames Dropped	Database Search (min:sec)
▲ Higher scores represent better performance.	▲	▲	▲	▲	▲	▲	▲	▼	▼	▼
▼ Lower scores represent better performance.	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
Aberdeen P100-PCI (P/100)	4,933	295	15.5	14.1	14.8	16.8	536	62	0	2:23
Aberdeen NxP100 (Nx-P100)	3,345	711	13.8	12.2	12.3	13.9	600	69	0	2:49
AcerAcros 75 (P/75)	2,387	502	12.8	11.8	11.9	14.0	600	33	0	5:07
AcerAcros 120 (P/120)	4,686	852	17.7	15.7	17.4	19.8	615	30	0	2:29
ACMA P75 (P/75)	4,052	605	12.3	11.4	11.5	13.3	548	57	0	4:14
ACMA P100 (P/100)	5,155	737	15.5	14.0	14.9	17.5	601	48	0	2:16
Alaris Nx586 P100 (Nx-P100)	652	667	13.1	12.3	12.1	13.4	379	29	0	6:01
AMAX Powerstation 75 (P/75)	4,056	609	12.6	11.7	11.9	13.3	547	57	0	4:19
AMAX Powerstation 100 (P/100)	5,133	619	15.7	14.0	15.1	17.2	601	14	0	3:00
AMS Infogold P75 (P/75)	4,058	578	12.1	11.1	11.5	12.8	547	57	0	4:21
AMS Infogold P100 (P/100)	4,992	716	15.0	13.6	14.3	14.9	600	53	0	4:08
AST Premia (P/100)	3,128	787	15.1	13.6	15.0	17.1	300	42	2	2:56
Austin 75 (P/75)	3,554	601	13.0	12.0	12.2	14.1	602	33	0	3:50
Austin 100 (P/100)	4,879	801	17.8	15.7	17.4	19.7	601	36	0	2:00
Austin 120 (P/120)	4,623	776	18.4	16.0	18.3	20.6	601	31	0	3:18
Blackship NX-80 (Nx-P80)	2,811	601	9.9	9.2	9.2	10.1	299	52	0	3:03
Blackship NX-100 (Nx-P100)	3,431	657	12.2	11.3	11.7	13.0	298	59	0	3:04
Compaq 590 (P/90)	652	743	12.6	12.3	12.4	14.5	N/A ¹	N/A ¹	N/A ¹	N/A ¹
CompuAdd CP75p (P/75)	4,083	487	12.4	11.4	12.0	13.5	602	37	0	2:57
CompuAdd CP100p (P/100)	5,259	747	17.0	15.1	16.8	19.4	601	23	0	4:53
Comrade Tornado (P/75)	4,046	611	12.6	11.6	11.7	13.6	601	37	0	2:54
Comrade Dream Machine (P/100)	5,068	737	15.5	14.0	14.7	16.8	602	35	0	2:39
Cornell P75 (P/75)	3,341	529	11.5	10.4	10.6	12.0	299	77	0	3:35
Cornell P100 (P/100)	5,641	678	14.5	13.0	13.8	15.2	579	61	0	2:18
DataStor NX5-80 (Nx-P80)	2,738	467	7.8	8.7	8.7	7.1	300	57	0	3:15
DataStor NX5-100 (Nx-P100)	3,367	728	13.2	12.2	11.9	13.3	300	49	0	3:03
Dell XPS P75 (P/75)	4,705	553	12.0	10.7	11.7	13.3	602	37	0	2:33
Dell XPS P90 (P/90)	5,391	629	13.6	12.5	13.7	15.2	300	49	0	3:23
Dell XPS P100 (P/100)	5,250	853	16.7	15.6	17.7	20.0	602	26	0	4:35
Dell XPS P120 (P/120)	1,672	988	18.6	16.9	18.8	20.9	601	24	0	4:39
DFI Diamond P100 (P/100)	5,233	679	14.5	12.6	14.4	16.7	601	35	0	3:40
Diamond Thunder (P/75)	4,201	503	12.4	11.3	11.4	13.5	300	63	0	3:53
Diamond Power Server (P/100)	4,319	664	14.8	13.1	14.2	16.1	301	66	0	3:50
Digital 575 (P/75)	3,462	565	11.5	10.5	11.2	13.4	300	60	0	3:16
Digital XL 5100 (P/100)	5,874	783	15.4	13.9	14.7	16.9	513	37	0	1:58
DTK QUIN-35 (P/75)	2,876	376	7.6	7.5	7.3	8.4	600	59	186	2:43
DTK QUIN-52 (P/100)	3,078	661	11.3	10.9	11.3	13.5	566	55	0	4:14
Duracom MiniPro (Nx-P100)	3,344	612	11.6	10.6	10.9	11.4	601	20	0	4:05
Ergo ThunderBrick (P/100)	4,929	711	16.6	14.9	16.7	19.1	300	47	0	5:50
Everax Step SP/75 (P/75)	3,926	590	11.5	10.4	11.1	13.0	454	69	0	4:29
Everax Step SP/100 (P/100)	4,880	602	13.9	12.0	13.6	16.5	497	65	0	2:32
Gateway P5-75 (P/75)	3,489	566	12.7	11.7	11.9	13.5	602	38	0	2:50
Gateway P5-100XL (P/100)	4,892	711	17.5	15.7	17.5	21.9	602	27	0	2:37
Gateway P5-120 (P/120)	4,559	890	19.2	17.1	19.4	24.0	602	35	0	3:53
GST PT75 (P/75)	4,057	554	12.2	11.2	11.5	13.0	405	73	0	4:55
GST PT100 (P/100)	3,088	625	13.5	12.2	12.6	15.0	601	25	0	1:49
Hertz P75e (P/75)	4,202	592	12.8	11.6	11.8	13.9	300	67	0	2:53
Hertz P100e (P/100)	4,911	769	17.1	15.2	16.8	19.2	299	51	0	2:49
HR P5-75 (P/75)	4,040	596	12.6	11.5	12.0	13.7	602	27	0	1:54
HR P5-100 (P/100)	4,869	717	15.0	13.5	14.3	16.9	600	24	0	1:46

N/A¹—Not applicable: The product did not ship with a CD-ROM drive. N/A²—Not applicable: The product could not perform these tests.



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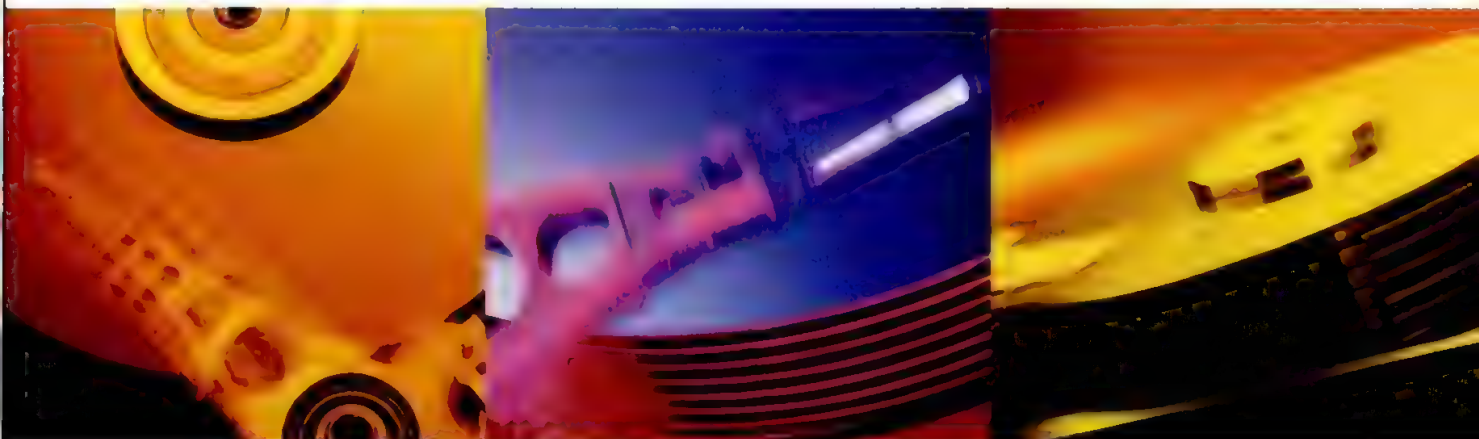
▲ Higher scores represent better performance.
▼ Lower scores represent better performance.

	DOS		WINSTONE 95				CD-ROM			
	Video	Disk	Spread-sheet	Word Processing	Database	Business Graphics/ DTP	Maximum Throughput (KBps)	CPU Utilization (percent)	Video Frames Dropped	Database Search (min:sec)
HP VL 5/75 (P/75)	3,593	586	11.6	10.8	11.4	13.5	301	32	0	2:42
HP VL 5/90 (P/90)	3,784	664	13.1	11.9	13.0	15.7	301	34	0	2:37
HP VL 5/120 (P/120)	3,837	743	14.1	12.8	14.0	18.7	301	28	7	4:27
HP XU 5/100C (P/100)	669	801	15.9	14.7	15.8	18.5	300	37	0	5:17
IBM 750-P90 (P/90)	2,877	603	13.0	11.9	12.9	15.5	300	41	0	3:18
Insight P75 MM (P/75)	4,051	613	12.7	11.6	12.0	13.6	600	37	0	2:44
Insight P100 MM (P/100)	5,262	772	17.5	15.5	17.3	19.7	601	30	0	2:33
Insight P120 MM (P/120)	5,131	826	18.4	16.4	18.4	21.3	601	30	0	2:28
Intelecs Star 75 (P/75)	4,059	539	N/A ²	N/A ²	N/A ²	N/A ²	492	66	0	2:32
Maximus Magna Media (P/75)	2,982	537	12.5	11.6	11.6	13.7	601	26	0	5:04
Maximus Magna Graphics (P/100)	3,883	738	15.2	13.8	14.5	17.0	601	23	0	4:55
Maximus Winmax95 (Nx-P80)	2,636	693	12.0	11.3	10.6	12.0	602	30	0	5:05
Maximus Musicmax (Nx-P100)	3,219	732	14.0	12.9	12.7	14.3	601	26	0	5:03
Mega Impact (P/100)	3,920	590	15.6	14.0	15.0	17.3	300	24	0	4:32
Micro Express MicroFLEX (P/75)	2,377	556	N/A ²	N/A ²	N/A ²	N/A ²	602	30	0	1:52
Micron P75 PowerStation (P/75)	3,339	584	12.8	11.7	11.5	13.6	601	41	0	3:01
Micron P100 Millennia (P/100)	5,278	801	17.4	15.4	16.8	18.8	601	36	0	2:05
Micron P120 Millennia (P/120)	5,141	910	19.2	17.0	18.9	22.3	601	30	0	2:59
MidWest Micro P5-75 (P/75)	3,515	585	12.9	11.7	12.1	13.1	300	49	0	3:32
MidWest Micro P5-100 (P/100)	4,889	801	17.8	15.9	17.3	19.8	300	42	0	3:17
MidWest Micro P5-120 (P/120)	4,558	917	18.6	16.5	18.9	21.1	546	31	45	2:48
Mitac Performance 75 (P/75)	4,223	472	10.6	10.2	10.0	10.5	535	58	0	4:30
Mitac Performance 100 (P/100)	4,435	586	10.1	8.5	9.8	10.1	535	58	0	4:39
NMC Expert-System (P/75)	3,609	597	11.5	10.4	11.1	13.4	358	83	0	2:40
NEC PowerMate (P/75)	3,982	594	11.2	10.3	10.8	12.8	600	28	0	2:43
Polywell Poly 575IP (P/75)	4,059	443	11.7	10.6	11.0	12.7	299	66	0	2:52
Polywell Poly 51002 (P/100)	4,810	794	14.6	13.3	14.5	16.1	483	89	0	2:31
Reason Square 5-LXP/IP-75 (P/75)	4,045	567	12.3	11.5	11.7	13.0	601	39	0	2:47
Reason Square 5-LXP/IP-100 (P/100)	1,685	708	14.4	13.5	14.3	14.4	601	21	9	1:43
Robotech Cobra (P/100)	5,129	769	14.6	13.1	14.9	16.7	538	61	0	2:20
Summit Mount Brooks (P/75)	4,246	481	11.9	10.7	10.9	12.7	299	60	0	5:28
Summit Mount McKinley (P/100)	4,912	762	16.8	15.0	16.8	19.3	601	23	0	4:41
Sys P100T (P/100)	4,881	803	17.8	16.1	17.5	20.5	604	21	0	1:39
Tagram P75 (P/75)	3,659	652	13.0	12.2	12.4	14.8	299	79	0	2:56
Tagram P100 (P/100)	4,587	775	18.4	14.8	15.4	18.3	525	63	0	2:18
Tangent PCI 575 (P/75)	3,916	544	12.4	11.5	11.8	13.8	301	37	0	5:44
Tangent PCI 5100 (P/100)	4,812	602	15.5	13.8	15.2	17.3	497	66	0	2:27
Tangent NX5-P80 (Nx-P80)	2,774	562	11.6	10.9	10.4	11.6	301	31	0	6:08
Tangent NX5-P100 (Nx-P100)	3,334	818	13.4	12.5	12.4	13.7	300	28	0	4:33
TC-P5-75 Media (P/75)	3,966	540	11.7	10.5	11.2	12.7	508	59	0	4:24
Tri-CAD P-75 (P/75)	3,703	572	11.8	10.7	11.0	12.8	603	23	0	4:53
Tri-CAD NTP100 (P/100)	3,977	714	14.7	13.6	14.6	15.4	602	25	0	3:36
Unisys SVI 51007 (P/100)	664	618	13.6	12.9	13.2	13.9	602	25	0	1:44
Unitex UT-P100 (P/100)	4,470	679	15.5	14.0	15.0	16.8	602	34	0	2:45
USA Flex PT-75 (P/75)	4,047	566	11.7	10.5	11.3	13.0	301	37	7	2:33
USA Flex PT-100 (P/100)	4,470	663	15.5	13.7	14.7	16.4	601	34	0	3:08
ZDS Z-Station (P/90)	4,152	840	14.5	13.8	13.8	15.9	301	50	0	3:15
Zenon Dream Media (P/100)	4,891	801	17.1	15.4	17.0	19.7	600	22	0	5:00
ZEOS Pentium-75 (P/75)	3,956	580	12.5	11.4	12.0	13.7	602	34	0	2:49
ZEOS Pentium-100 (P/100)	4,697	699	14.8	13.3	14.6	16.3	603	29	0	2:36

N/A¹—Not applicable. The product did not ship with a CD-ROM drive. N/A²—Not applicable. The product could not perform these tests.

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Things change fast in the data storage business. But one thing that hasn't changed over these past years is Seagate's commitment to advancing disc drive technology to meet the ever-expanding storage needs of our customers.

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CIRCLE 271 ON READER SERVICE CARD

GST/Micro City

Apogee PT75 Apogee PT100

Though both of the reviewed GST PCs—the Pentium/100-based GST Apogee PT100 and the Pentium/75-based GST Apogee PT75—are attractively priced, only the latter proved to be a true bargain. The \$2,799 (street price) PT75 posted average scores on all of our benchmark tests, but the \$3,299 (street price) PT100 was a disappointing performer in its CPU class.



IN SHORT

The 75-MHz GST machine is a better buy than its 100-MHz sibling.

Both machines came in tower cases, but they were equipped with different motherboards. The PT100 used a SIS motherboard, while the PT75's motherboard was powered by Intel's Neptune chip set.

Both systems came with Diamond Stealth 64 graphics cards with 2MB of VRAM, and both used Creative Labs sound cards: the PT100 used a Sound Blaster 16 SCSI whereas the PT75 used a Sound Blaster Pro. The two systems used 15-inch Proton monitors with built-in speakers. Both also came with quad-speed CD-ROM drives; the PT100's Toshiba drive adds an extra \$200 to the system's price, compared with the price of the PT75's TEAC drive.

Although the PT75 logged average scores on all of our benchmark tests, the PT100 did not fare as well. It posted an average score on the Disk WinMark 95 tests but below-average scores for its CPU class on the Graphics WinMark 95 and Winstone 95 tests. The top scorers in the Pentium/100 class received a performance boost from their installed Triton chip sets and EDO DRAM, both of which the PT100 lacked.—RSA

GST/Micro City, Cerritos, CA; 800-567-2764, 714-739-0106; fax, 714-739-8291.

Circle 484 on reader service card

Hertz Computer Corp.

Hertz P75e Hertz P100e

Hertz Computer Corp., which sells PCs primarily to corporate, government, and education accounts, has built two powerful systems that combine excellent performance and moderate prices.

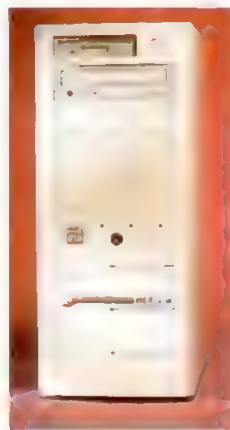
The Hertz P75e (\$2,645) and Hertz P100e (\$2,995) came in the same tower case but used different motherboards.



**The Hertz systems combine
excellent performance and
moderate prices.**

The P100e maximized the combination of a Pentium/100 CPU and Triton chip set by using synchronous-burst L2 cache and EDO DRAM. The result: a higher-than-average CPUmark₁₆ score and a strong showing on our Winstone 95 tests.

The P75e mated its Pentium/75 CPU with a SIS chip set and 512K of L2 cache. The larger-than-average cache helped it garner a CPUmark₁₆ score that was second to that of only one system in its CPU class—the Tagram Thunderbolt P75, equipped with a full megabyte of L2 cache. As with the P100e, the high performance of the CPU-memory subsystem on the P75e contributed to its superior Winstone 95 score.



IN SHORT

Hertz offers good Pentium values for the power-hungry but budget-conscious user.

Both units used ATI 64-bit graphics cards with 2MB of VRAM; the P100e lever-

aged this board into an above-average Graphics WinMark 95 score. The P75e's Graphics WinMark result placed it among the top few Pentium/75 units we tested. The P100e's Disk WinMark 95 score was above average while the P75e's was average.—RSA

Hertz Computer Corp., New York, NY; 800-232-8737, 212-684-4141; fax, 212-684-3658.

Circle 485 on reader service card

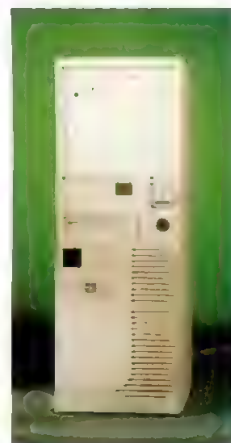
Hewitt Rand Corp.

HR P5-75 Tower HR P5-100 Tower

With top-level performance on our Windows-based graphics tests, Hewitt Rand's HR P5-75 Tower (\$2,799 street price) and HR P5-100 Tower (\$3,499 street price) proved themselves to be solid Pentium workhorses at good price points. Hewitt Rand markets mainly to small business and government accounts. The company adds a \$99 software bundle—which includes Microsoft's Encarta, Money, and Works—to these units for home consumers.

Both of these units stood out on our Graphics WinMark 95 tests, where the P5-75 posted the best score among tested Pentium/75 PCs and the P5-100 yielded one of the best scores in its 100-MHz Pentium class. Both machines used a Diamond Stealth card with the newer S3 Vision 968 chip set and 2MB of VRAM. Other benchmark test results were average.

The P5-75 came configured with a 687MB hard disk while the P5-100 came with a 1GB hard disk. Both of the systems used quad-speed CD-ROM drives, Sound Blaster 16 sound cards, and 15-inch MAG InnoVision monitors. Both the P5-75 and the P5-100 used the same Neptune motherboard, which offered three PCI expan-



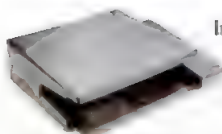
IN SHORT

These affordable Pentium PCs provide strong graphics performance.

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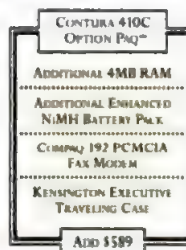
COMPAQ
CONTURA 410C

\$2,499

OR 190
PER MONTH*

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a 350MB hard drive and a new wall-mount AC adapter. Yet we kept the weight under six pounds.



CONTURA 410C FEATURES:

- 486DX2/50MHZ PROCESSOR
- 4MB RAM (UPGRADABLE TO 20MB)
- 350MB HARD DRIVE
- TWO PCMCIA TYPE II SLOTS (OR ONE TYPE III)
- 3.5" DISKETTE DRIVE
- 9.5" COLOR DUAL SCAN DISPLAY
- LOKAL BUS GRAPHICS
- INTEGRATED TRACKBALL
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Pentium and Nx586 PCs

sion slots and five ISA slots (one slot was shared).

Hewlett Rand offers a seven-year motherboard warranty, a two-year parts-and-labor system warranty, and a year of free shipping for warranty service.—RSA

Hewlett Rand Corp., Redmond, WA; 800-869-7074, 206-869-5555; fax, 206-869-5151.

Circle 486 on reader service card

Hewlett-Packard Co.

HP Vectra VL 5/75

HP Vectra VL 5/90

HP Vectra VL 5/120

HP Vectra XU 5/100C

Hewlett-Packard Co. is one of the few companies that still does significant systems engineering—and it shows. The \$5,625 HP Vectra XU 5/100C (Pentium/100), the \$4,280 HP Vectra VL 5/120 (Pentium/120), the \$3,310 HP Vectra VL 5/90 (Pentium/90), and the \$2,923 HP Vectra VL 5/75 (Pentium/75) were mostly good performers on our tests.

Though the Vectra VLs would do well in the home, the XU 5/100, which has integrated Ethernet and SCSI ports, is clearly an office PC.

All VL-series units had HP motherboards, which integrate I/O ports and 64-bit Cirrus Logic-based graphics subsystems. The XU 5/100 had a Matrox graphics card with 4MB of VRAM and includes a Cardinal Digital Sound Pro16+ card. The Vectras' cases feature hinged drive cages and power supplies, which swing up out of the way for easy motherboard access.

The VL 5/90 and VL 5/75 had average scores on all Windows-based tests. The VL 5/120, however, posted the lowest scores in its class on our Win-

dows-based tests. The XU 5/100 had above-average scores on the Graphics WinMark 95 and Disk WinMark 95 tests and average scores on the Winstone 95 tests.—RSA

Hewlett-Packard Co., Palo Alto, CA; 800-752-0900, 303-635-1000; fax, 800-333-1917.

Circle 487 on reader service card

IBM Personal Computer Co.

IBM PC 750-P90

The PC 700 Series is IBM's PC line for mission-critical business environments. IBM also sells the value-priced PC 300 Series and the home-oriented Aptiva line (neither reviewed here). In addition to excellent design, the 700-series machines incorporate preloaded asset management features, extensive security features, and superb utilities software.

We tested the \$6,084 IBM PC 750-P90 (IBM Direct price). This system includes a 17-inch monitor, a \$473 upgrade from a 15-inch monitor. It uses IBM's SelectaBus architecture: All bus circuitry is on a riser card, so you can choose (and later swap to) either PCI or Micro Channel slots. (This unit was configured with a PCI riser card.)

The 750-P90 comes with IBM's NetFinity software, which lets network administrators remotely monitor system status and control hard disk, floppy disk drive, and serial and parallel port I/O. The unit also has great productivity tools such as Online Housecall, which lets you run applications, transfer files, or send e-mail.

The IBM PC 750-P90 had an above-average Disk WinMark 95 score and average results on the Winstone 95 and Graphics

WinMark 95 tests.—CV

IBM Personal Computer Co., Somers, NY; 800-426-2968, 919-517-1331; fax, 800-426-3395.

Circle 488 on reader service card

Insight Direct Inc.

Insight PCI P75 MM
Insight PCI P100 MM
Insight PCI P120 MM

The Insight PCI MM line is no stranger to *PC Magazine*: a 90-MHz version received an Editors' Choice in our issue of December 6, 1994. The newest members of this family—the \$3,299 PCI P75 MM, \$4,199 PCI P100 MM, and the \$4,499 PCI P120 MM—have much the same appeal: strong performance and impressive features.

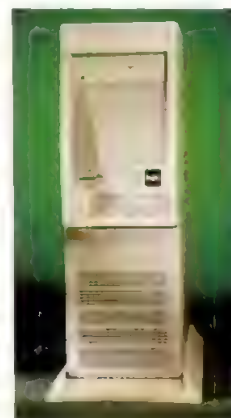
The three Insight systems came in tower cases with some great extras, including quad-speed IDE CD-ROM drives, internal 28.8-Kbps modems, external speakers, and 17-inch monitors (the P75 MM's is from MAG InnoVision, and the P100 MM and P120 MM use slightly higher-resolution Idek monitors). The P75 MM's audio capabilities are provided by a Sound Blaster 16 SCSI card, while the P100 MM and P120 MM use their Intel motherboards' built-in 16-bit sound chip.

The Insight machines were also impressive performers. The Triton-based P100 MM and P120 MM were among the top scorers on our Winstone 95 tests, boosted by their installed EDO DRAM and 256K of pipelined-burst cache. The P75 MM's test scores were average to above average on all tests.

The Insight PCs are covered by three-year parts, one-year labor warranties. Insight offers express parts replacement but does not offer an on-site service option.—CV

Insight Direct Inc., Tempe, AZ; 800-729-0770, 602-902-1176; fax, 602-902-1180.

Circle 489 on reader service card



IN SHORT

You'll get great performance and extras from these mammoth tower PCs.

SERVICE & RELIABILITY

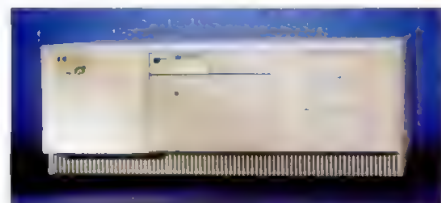
Reliability	Average
Repair service	Above average
Tech support	Above average

IN SHORT

Good performance and design make most of HP's Vectras good bets.

SERVICE & RELIABILITY

Reliability	Above average
Repair service	Above average
Tech support	Above average

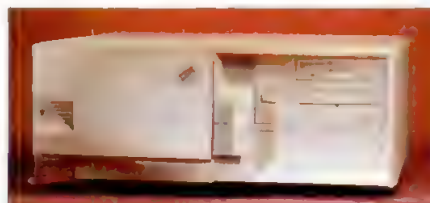


IN SHORT

IBM's machines are high-priced but offer features few PCs can match.

SERVICE & RELIABILITY

Reliability	Above average
Repair service	Above average
Tech support	Above average



Intelesys Inc.

Intelesys Star 75

The \$2,499 Intelesys Star 75 is proof that a system with great components isn't necessarily a great PC. The Intelesys Star 75 was housed in a big tower case with a quad-speed CD-ROM drive, a 687MB Fast ATA hard disk (850MB disks are now standard), a Boca Research 14.4-Kbps fax modem with 16-bit sound and voice mail support, and a home-oriented software bundle—an appealing combination at a low price. On a less positive note, the unit also came to us with



IN SHORT

The Intelesys system couldn't complete our Winstone 95 tests.

a Pentium CPU that ran at 90 MHz rather than its rated 75-MHz speed. When we reset a motherboard jumper to step the machine down to 75 MHz, the Star 75 was unable to run our Winstone 95 benchmark tests; the company could not help us diagnose the problem.

Intelesys insists that it wasn't aware the CPU was overclocked,

which makes us wonder about the company's quality-control procedures. In any case, we don't recommend hot-rodding CPUs; this procedure invalidates Intel's warranty on the processor and also raises reliability concerns.

On our remaining Windows-based benchmark tests the Intelesys Star 75 produced average scores except for its Disk WinMark 95 score, which was below average. The Star 75 also garnered a slightly below-average score on our CPUmark₁₆ tests, which contributed to its low Disk WinMark score.

Intelesys provides 24-hour, 7-day technical support and a one-year parts, three-year labor warranty. The system's warranty also includes one year of on-site service.—CV

Intelesys Inc., Fremont, CA; 800-577-

3486; 510 336 6300; FAX 510 336 6303

SUMMARY OF FEATURES

Continues

Pentium and Nx586 PCs

List price For machines sold through resellers, assume street prices will be 15 to 20 percent lower than what is listed. A price marked *street* is the vendor's estimated street price, indicating that the vendor has factored in this discount.

Processor Numeric suffixes to the Pentium name indicate clock speeds in megahertz. NexGen's Nx586 CPUs are each named after the Pentium version that the company believes to be most equivalent. But the Nx586-P100 actually runs at 93 MHz, while the Nx586-P80 runs at 75 MHz.

Installed RAM Some machines use *EDO* (extended data out) DRAM, which can marginally boost performance over standard fast-page mode DRAM.

Hard disk interface *EIDE* denotes Enhanced IDE, an extension to IDE that supports faster transfer rates, higher disk capacities, and mass-storage devices other than hard disks. *Fast ATA* denotes Seagate's EIDE-like specification for increased transfer rates and larger capacities.

CD-ROM drive interface *ATAPI* is a specification that enables CD-ROM drives to act much like hard disks, which allows them to be connected to

Enhanced IDE interfaces. *Proprietary* drives connect to a special connector on a sound board.

DOS, Windows versions included *DOS* implies MS-DOS, unless otherwise specified. *WWG* denotes Windows for Workgroups, and *Win* indicates Windows.

Flash BIOS replaces conventional ROM storage and can be electronically reprogrammed, making the BIOS upgradable simply by downloading new software.

A Plug and Play BIOS can map out motherboard resources to ease upgrades when used with a Plug and Play-compliant operating system (such as Windows 95 or forthcoming versions of OS/2).

Expansion-bus slots VL-Bus slots are physical extensions of ISA or EISA bus slots and can also accommodate ISA or EISA cards. PCI cards may share a backplate with ISA cards, meaning that you can use one or the other, but not both simultaneously. These shared slots are listed as *PCI/ISA*.

EPP/ECP parallel interfaces supported The Enhanced Parallel Port and Extended Communications Port standards allow higher throughput than a standard Centronics parallel port.

average Disk WinMark score.

Since the Pentium and NexGen systems at similar processor levels are comparably equipped, only performance differences remain. For virtually the same price, the Pentium/100 and Pentium/75 units provide 11 and 7 percent more performance, respectively, on our

Winstone tests than do their NexGen counterparts. Thus they're a better buy for the money. The 100-MHz Pentium gains a slight advantage because it uses 512K of L2 cache.—Mary E. Behr

Maximus Computers Inc., Monrovia, CA; 800-888-6294, 818-305-5925; fax, 818-357-9140.

Maximus Computers Inc.

Magna Graphics Media

Magna Media

Musicmax Nx586

Winmax95 Nx586

Maximus aims its PCI/ISA Pentium/100-based Magna Graphics Media (\$3,295) tower at CAD users and desktop publishers. The Pentium/75-based Magna Media (\$2,195) midtower is aimed at mainstream users. Maximus also sells VL-Bus/ISA units based on the Nx586 processor, including the \$3,195 Nx586-P100-based Musicmax Nx586 tower and the \$2,195 Nx586-P80-based Winmax95 Nx586 midtower.

The Graphics Media's and Magna Media's performance under Windows was generally average, highlighted by the Magna Media's above-average Disk WinMark 95 score. Relative to other machines in its CPU class, the Winmax95 was the best performer of the Maximus lot, producing above-average Disk WinMark and



IN SHORT

These systems are nearly average in terms of price and



© 1995 Intel Corporation. *Source: iCOMP95: A Simplified Measure Of Relative Microprocessor Performance. Intel Corporation, 1992. **The 65-MHz Pentium OverDrive processor for most 50-MHz and 25-MHz Intel486™ CPU-based systems is available now. The 83-MHz Pentium OverDrive processor for most 66-MHz and 33-MHz Intel486 CPU-based systems will be available later in the year. *Other trade names referenced are the property of their respective holders.

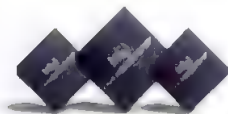
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Drive[®] processor upgrade.

SUMMARY OF FEATURES

Pentium and Nx586 PCs

■ YES ■ NO

Products listed in review order

	Aberdeen P100-PCI	Aberdeen NxP100	Acer/Across Pentium 75	Acer/Power Pentium 120	ACMA P75	ACMA P100	Alaris Nx586 P100	AMAX Powerstation 75
List price (tested configuration)	\$3,499	\$2,899	\$3,499 (street)	\$4,245 (street)	\$3,195	\$3,995	\$2,798 (street)	\$2,999
Processor	Pentium/100	Nx586-P100	Pentium/75	Pentium/120	Pentium/75	Pentium/100	Nx586-P100	Pentium/75
Installed RAM	16MB	16MB	16MB	16MB	16MB	16MB	16MB	16MB
Hard disk capacity and interface	1GB EIDE	1GB EIDE	773MB EIDE	1GB Fast ATA	812MB EIDE	1.2GB EIDE	1GB EIDE	1.1GB EIDE
Graphics adapter (and memory)	Diamond Stealth 64 (2MB)	Diamond Stealth 64 (2MB)	ATI Graphics Pro Turbo (4MB)	Diamond Stealth 64 (2MB)	Diamond Stealth 64 (4MB)	Diamond Stealth 64 (4MB)	Matrox MGA 2T VL (2MB)	Diamond Stealth 64 (4MB)
Monitor (and diagonal screen size)	Orchestra Tube (17")	Orchestra Horn (15")	AcerView 76i (17")	AcerView 76i (17")	MAG DX17F (17")	MAG DX17F (17")	IBM 15V (15")	MAG DX15F (15")
CD-ROM drive (and speed and interface)	TEAC CD-55A SuperQuad (4x proprietary)	TEAC CD-55A SuperQuad (4x proprietary)	Mitsumi CRMC-FX400 (4x ATAPI)	Mitsumi CRMC-FX400 (4x ATAPI)	TEAC CD-55A SuperQuad (4x proprietary)	TEAC CD-55A SuperQuad (4x proprietary)	Mitsumi CRMC-FXN01DE (2x ATAPI)	TEAC CD-55A SuperQuad (4x proprietary)
Sound adapter	Creative Labs Sound Blaster 16 MCD	Creative Labs Sound Blaster 16 MCD	Acer Magic S20	Acer Magic S20	Creative Labs Sound Blaster 16	Creative Labs Sound Blaster 16	Creative Labs Sound Blaster 16 Value	Creative Labs Sound Blaster 16 MCD
Speakers/Network adapter/Modem included	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■
DOS, Windows version included	6.22, WinWg 3.11	6.22, WinWg 3.11	6.22, WinWg 3.11	6.2, WinWg 3.11	6.22, WinWg 3.11	6.22, WinWg 3.11	6.22, WinWg 3.11	6.22, WinWg 3.11
Motherboard Components								
Installed, maximum external RAM cache	256K, 256K	256K, 256K	256K, 256K	256K, 256K	256K, 512K	256K, 256K	256K, 256K	256K, 256K
Motherboard manufacturer	Intel	Alaris	Acer	Acer	FCT	Intel	Alaris	Intel
Chip set manufacturer and model	Intel Neptune	NxGen NxVL	Intel Neptune	Intel Triton	Intel Neptune	Intel Triton	NxGen NxVL	Intel Neptune
BIOS manufacturer and version (or date)	AMI (11/30/94)	AMI 0050033S	Acer (9/21/94)	Acer 2.0	AMI (10/10/94)	AMI (1/27/95)	AMI (11/11/92)	AMI (1/27/95)
Flash BIOS/Plug and Play BIOS	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Multiprocessor socket	■	■	■	■	■	■	■	■
Expandability								
Maximum RAM	128MB	192MB	128MB	128MB	128MB	128MB	192MB	128MB
Expansion-bus slots	4 ISA, 2 PCI, 1 PCI/ISA	5 ISA, 2 VLB	5 ISA, 2 PCI, 1 PCI/ISA	3 ISA, 3 PCI, 1 PCI/ISA	4 ISA, 2 PCI, 1 PCI/ISA	3 ISA, 2 PCI, 1 PCI/ISA	5 ISA, 2 VLB	4 ISA, 2 PCI, 1 PCI/ISA
Accessible drive bays (5.25", 3.5")	3, 0	3, 0	2, 2	3, 2	5, 2	5, 2	5, 2	4, 1
Internal drive bays (5.25", 3.5")	0, 2	0, 2	0, 2	0, 2	1, 1	1, 1	0, 2	0, 1
Power-supply wattage	250W	250W	200W	200W	250W	250W	300W	250W
Parallel, serial, mouse ports	1, 2, 0	1, 2, 0	1, 2, 1	1, 2, 1	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0
EPP/ECP parallel interfaces supported	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Service and Support								
7-day, 24-hour live technical support	■	■	■	■	■	■	■	■
Standard warranty on parts/labor	2 years/Lifetime	2 years/Lifetime	3 years/3 years	3 years/3 years	1 year/1 year	1 year/1 year	3 years/3 years	1 year/1 year
On-site service charge (and term)	Varies	Varies	Included (1 year)	Included (1 year)	Included (1 year)	Included (1 year)	\$79 (1 year)	Included (1 year)

BCM—BCM Advanced Research, FCT—Free Computer Technology, FIC—First International Computer.

Mega Computer Systems

Mega Impact Pentium 100

Mega Computer Systems' Mega Impact Pentium 100 is aimed at business users looking for a powerful, general-purpose PC. The 100-MHz Pentium-powered machine we tested is well suited to this task: Its performance was on a par with that of the competition, and at \$2,999, it's reasonably priced and well designed to boot.

The Mega Impact's tower case has two great features: tool-free access and snap-on hard disk brackets, so front-mounted devices slide out easily. Inside the case is a double-speed CD-ROM drive and a Sound Blaster 16

audio card, which supports wavetable synthesis.

This unit was one of only three that we tested with 1MB of L2 cache. It only costs \$135 to upgrade to 1MB of cache, but our tests have proven that gains in application performance are minimal in machines with L2 caches larger than 512K. And the Mega Impact's test results bear this out: Although its CPUmark₁₆ score was marginally boosted by the extra cache, its scores on our Windows-based tests, where peripherals come into play, were all average.

Mega also sells the Pioneer line of PCs, which comes preloaded with a network interface card and either Novell's NetWare or

Microsoft Windows NT to function as servers; workstation configurations are also available. For users emphasizing multimedia capabilities, Mega offers the Horizon line, which includes dual- or quad-speed CD-ROM drives and the Microsoft Family Pack.—CV

Mega Computer Systems, San Diego, CA; 800-338-6628, 619-487-8888; fax, 619-485-1518.
Circle 492 on reader service card



IN SHORT

Mega's PC provides average performance at a good price.

Continues

PC MAGAZINE EDITORS' CHOICE				PC MAGAZINE EDITORS' CHOICE					
AMAX Powerstation 100	AMS Infogold P75	AMS Infogold P180	AST Premia GX P/100	Austin Power Plus 75	Austin Power Plus 100	Austin Power Plus 120	Blackship NX-80 Nautilus	Blackship NX-100 Nautilus	Compaq Deskpro XL 530 Model 535
\$3,999	\$2,595	\$2,995	\$5,080 (street)	\$2,699	\$3,499	\$4,499	\$1,995	\$2,495	\$4,598 (street)
Pentium/100	Pentium/75	Pentium/100	Pentium/100	Pentium/75	Pentium/100	Pentium/120	Nx586-P80	Nx586-P100	Pentium/90
16MB	16MB	16MB	16MB	16MB	16MB EDO	16MB EDO	16MB	16MB	16MB
1.1GB EIDE	540MB EIDE	1GB SCSI-2	1GB Fast ATA	812MB EIDE	1.2GB EIDE	1GB EIDE	504MB EIDE	1GB EIDE	535MB SCSI-2
Diamond Stealth 64 (4MB)	Diamond Stealth 64 (2MB)	Diamond Stealth 64 (2MB)	ATI Graphics Pro Turbo (2MB)	ATI Graphics Xpression (2MB)	ATI Graphics Pro Turbo (4MB)	ATI Graphics Pro Turbo (4MB)	Spider 32VLB V1 4 (2MB)	Spider 32VLB V1 4 (2MB)	Compaq QVision 2000 PCI (2MB)
MAG MXP17F (17")	Sony CPD-15SF1 (15")	Sony CPD-15SF1 (15")	AST ASTVision 5L (15")	Smile CA1507 (15")	Nokia Multigraph 447L (17")	Smile CA1718 (17")	Pacom KC51E (15")	Pacom KC51E (15")	Compaq 171 FS (17")
Toshiba XM-35018 (4x SCSI-2)	TEAC CD-55A SuperQuad (4x proprietary)	TEAC CD-55A SuperQuad (4x proprietary)	Sanyo CDR-H93RMV (2x SCSI-2)	Toshiba XM-5302B (4x ATAPI)	Toshiba XM-5302B (4x ATAPI)	Toshiba XM-5302B (4x ATAPI)	Panasonic CR-562-J (2x proprietary)	Panasonic CR-562-J (2x proprietary)	None
Creative Labs Sound Blaster 16 SCSI	Creative Labs Sound Blaster 16	Creative Labs Sound Blaster 16	Creative Labs Sound Blaster 16	Media Magic Telemetry-32	Media Magic ISP-16	Media Magic ISP-16	Creative Labs Sound Blaster 16	Creative Labs Sound Blaster 16	Integrated Com- paq AD1847JP
■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■
6.22, WFWg 3.11	6.22, WFWg 3.11	6.22, WFWg 3.11	6.21, WFWg 3.11	6.22, WFWg 3.11	6.22, WFWg 3.11	6.22, WFWg 3.11	6.22, WFWg 3.11	6.22, WFWg 3.11	6.22, Win 3.1
256K, 512K	256K, 256K	256K, 256K	512K, 512K	256K, 256K	256K, 256K	256K, 256K	256K, 256K	256K, 256K	256K, 256K
FCT	Intel	Intel	AST	Intel	Intel	Intel	Aleris	Aleris	Compaq
Intel Triton	Intel Triton	Intel Neptune	Intel Neptune	Intel Neptune	Intel Triton	Intel Triton	NexGen NxVL	NexGen NxVL	Compaq Deskpro
AMI (10/10/94)	AMI (8/23/94)	AMI (8/23/94)	AST (9/15/94)	AMI (11/30/94)	AMI (1/12/95)	AMI 1.00.01 BRO	AMI (11/11/92)	AMI (11/11/92)	Compaq (11/22/94)
■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
■	■	■	■	■	■	■	■	■	■
128MB	128MB	128MB	192MB	128MB	128MB	128MB	128MB	128MB	144MB
4 ISA, 3 PCI	4 ISA, 2 PCI, 1 PCI/ISA	4 ISA, 2 PCI, 1 PCI/ISA	5 EISA, 2 PCI	4 ISA, 2 PCI, 1 PCI/ISA	2 ISA, 3 PCI, 1 PCI/ISA	2 ISA, 3 PCI, 1 PCI/ISA	5 ISA, 2 VLB	5 ISA, 2 VLB	3 EISA, 1 PCI, 1 PCI/EISA
4, 1	3, 2	4, 2	2, 1	3, 1	3, 3	3, 2	2, 1	2, 1	3, 0
0, 2	0, 2	0, 2	0, 2	0, 2	0, 2	0, 2	0, 1	0, 1	0, 0
300W	220W	220W	230W	200W	200W	200W	250W	250W	240W
1, 2, 0	1, 2, 0	1, 2, 1	1, 1, 1	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 1
■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
■	■	■	■	■	■	■	■	■	■
1 year/1 year Included (1 year)	1 year/1 year \$65 (1 year)	1 year/1 year \$65 (1 year)	3 years/3 years Included (1 year)	3 years/3 years Included (1 year)	3 years/3 years Included (1 year)	3 years/3 years Included (1 year)	3 years/3 years Included (1 year)	3 years/3 years Included (1 year)	3 years/3 years Included (1 year)

Micro Express

MicroFLEX-PCI/P75

The MicroFLEX-PCI/P75, from Micro Express, is a \$2,499 Pentium/75-based mini-tower system from direct marketer Micro Express. The company targets this system, and all the PCs it sells, toward business users looking for a powerful general-purpose computer. Although the MicroFLEX system does have all the basic components to fulfill this need, including a Toshiba quad-speed CD-ROM drive, 16-bit Sound Blaster audio card, and a 15-inch monitor, it was not able to complete our Winstone 95 tests. Neither our labs nor Micro Express were able to

isolate or correct the problem on our test machine.

The MicroFLEX was one of the few in this roundup running Microsoft Windows 3.11; the majority of the systems we tested came preloaded with Microsoft Windows for Workgroups. Even though the system included a Promise PCI-based disk accelerator with 1MB of hardware disk cache, it still produced a below-average score on our Disk WinMark 95 tests. This result occurred because those systems running Windows for Workgroups were able to use that operating system's 32-bit file cache, which outperforms SmartDrive (or a hardware disk cache) alone.

On our Graphics WinMark 95 tests, the MicroFLEX,

which uses an ATI WinTurbo PCI-based graphics accelerator with 2MB of DRAM, garnered an average score.

Micro Express includes a two-year parts-and-labor warranty with the MicroFLEX-PCI/P75. Seven-day, 24-hour telephone technical support is also included, and onsite service is available for a fee.—CV

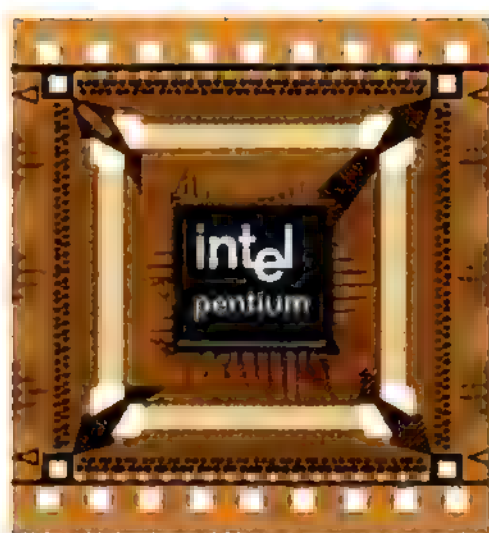
Micro Express,
Santa Ana, CA;
800-989-9900,
714-852-1400;
fax, 714-852-
1225.

Circle 493 on reader
service card



IN SHORT
*The Micro Express
unit couldn't
complete our
Winstone 95 tests.*

MOBILE PENTIUM.



INTRODUCING THE T4900CT PENTIUM NOTEBOOK.

The 75MHz mobile Pentium™ processor from Intel, with state-of-the-art Tape Carrier Packaging (TCP), is designed specifically for notebooks. Toshiba's engineers have crafted the T4900CT using this processor, so there is no need for fans or special cooling systems. Then they've added advances

T4900CT FEATURES:

- 75MHz Intel Pentium™, 3.3 volt processor, 16KB cache
- 10.4" dia. color SVGA TFT-LCD active matrix display
- 810 Million Byte (=772MB) HDD
- 8MB RAM expandable to 40MB
- Two PCMCIA slots (10.5mm and 5mm)
- VL local-bus video
- Integrated graphics accelerator
- 65,536 (64K) simultaneous colors
- WAV Audio and MIDI sound
- Audio jacks: headphone/speakers and microphone
- NiMH battery for extended life
- 6.9 lbs.
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- Accupoint™ integrated pointing device
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PORTABLE MAXIMUM.



Dock into the optional Desk Station IV for instant connection to your monitor, full-size keyboard, printer, and network.

The T4900CT with Desk Station IV is all the computer you need.

The 10.4" color active matrix screen displays 65,536 (64K) simultaneous colors for stunningly realistic images and brilliant graphics.

10.4" dia.

Take all your files with you, including full-motion video and multimedia with the 810 million bytes (=772MB) hard disk drive.

810 MILLION BYTES



indeo intel video technology
Indeo video bolstered by the 75MHz mobile Pentium provides smooth playback of full-motion and full-screen video.

The built-in sound system includes a microphone and speaker, plus ports for an external microphone and speakers or headphones.



Dual PCMCIA expansion slots (Type II and Type III) run simultaneously—for connection to your LAN, fax/modem and more.



like an AccuPoint™ integrated pointing device, 10.4" color active matrix display, and plug-and-play connection to peripherals. You can even blast MIDI and .WAV Audio through the built-in speaker or audio jacks for more dynamic multimedia presentations. See and hear this Pentium-powered touring machine today. **Call 1-800-457-7777 for the dealer nearest you.**

In Touch with Tomorrow
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CIRCLE 379 ON READER SERVICE CARD

SUMMARY OF FEATURES

Pentium and Nx586 PCs

■ YES ■ NO

Products listed in review order

	CompuAdd CP75p Desktop	CompuAdd CP100p Minitower	Comtrade Multimedia Tornado 4X P75	Comtrade Multimedia Dream Machine P100	Cornell PCI Power Workstation/ P75	Cornell Ultima/P100	DataStor NX5-80	DataStor NX5-100
List price (tested configuration)	\$2,916	\$3,482	\$2,495	\$2,895	\$2,295 (street)	\$3,595 (street)	\$2,725	\$3,225
Processor	Pentium/75	Pentium/100	Pentium/75	Pentium/100	Pentium/75	Pentium/100	Nx586-P80	Nx586-P100
Installed RAM	16MB	16MB EDO	16MB	16MB	16MB	16MB	16MB	16MB
Hard disk capacity and interface	696MB EIDE	730MB EIDE	773MB EIDE	1GB Fast ATA	540MB EIDE	1GB Fast ATA	504MB EIDE	1GB Fast ATA
Graphics adapter (and memory)	Diamond Stealth 64 (2MB)	Diamond Stealth 64 (2MB)	Diamond Stealth 64 (2MB)	Diamond Stealth 64 (2MB)	Diamond Stealth 64 (2MB)	Diamond Stealth 64 (2MB)	Diamond Stealth 64 (2MB)	Diamond Stealth 64 (2MB)
Monitor (and diagonal screen size)	CompuAdd TE1564M (15")	CompuAdd TE1564M (15")	CTX 1562GM (15")	Princeton Graphics KD-1500V (15")	ADI MicroScan 4GP (15")	ADI MicroScan 4GP (15")	ViewSonic 15ES (15")	ViewSonic 15ES (15")
CD-ROM drive (and speed and interface)	Mitsumi CRMC-FX400 (4x ATAPI)	Mitsumi CRMC-FX400 (4x ATAPI)	Mitsumi CRMC-FX400 (4x ATAPI)	Mitsumi CRMC-FX400 (4x ATAPI)	Panasonic CR-562-J (2x proprietary)	TEAC CD-55A SuperQuad (4x proprietary)	Aztech CDA-268-01A (2x proprietary)	Aztech CDA-268-01A (2x proprietary)
Sound adapter	Diamond Sound Card	Crystal CS4232	Orchid SoundWave 32	Orchid SoundWave 32	Creative Labs Sound Blaster 16	Creative Labs Sound Blaster 16	Aztech Voyager 32+	Aztech Voyager 32+
Speakers/Network adapter/Modem included	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■
DOS, Windows version included	6.2, WinWg 3.11	6.2, WinWg 3.11	6.22, WinWg 3.11	6.22, WinWg 3.11	6.22, WinWg 3.11	6.22, WinWg 3.11	6.22, WinWg 3.11	6.22, WinWg 3.11
Motherboard Components								
Installed, maximum external RAM cache	256K, 256K	256K, 512K	256K, 256K	256K, 256K	256K, 1MB	256K, 512K	256K, 1MB	256K, 1MB
Motherboard manufacturer	Intel	Intel	Intel	Intel	Super Micro	Cornell	NexGen	NexGen
Chip set manufacturer and model	Intel Neptune	Intel Triton	Intel Neptune	Intel Neptune	OPTi 82C556-58	Intel Neptune	NexGen NxVL	NexGen NxVL
BIOS manufacturer and version (or date)	AMI (11/30/94)	AMI 0.7.02.BRO	AMI (8/23/94)	AMI (8/23/94)	AMI (10/10/94)	Award (10/5/94)	AMI (11/11/92)	AMI (11/11/92)
Flash BIOS/Plug and Play BIOS	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Multiprocessor socket	■	■	■	■	■	■	■	■
Expandability								
Maximum RAM	128MB	128MB	128MB	128MB	256MB	512MB	128MB	128MB
Expansion-bus slots	4 ISA, 2 PCI, 1 PCI/ISA	2 ISA, 3 PCI, 1 PCI/ISA	4 ISA, 2 PCI, 1 PCI/ISA	4 ISA, 2 PCI, 1 PCI/ISA	4 ISA, 4 PCI	5 EISA, 2 PCI, 1 PCI/EISA	5 ISA, 2 VLB	5 ISA, 2 VLB
Accessible drive bays (5.25", 3.5")	3, 2	3, 1	2, 2	5, 0	3, 1	3, 0	3, 2	3, 2
Internal drive bays (5.25", 3.5")	0, 2	0, 3	0, 1	0, 3	0, 2	0, 3	0, 1	0, 1
Power-supply wattage	200W	200W	210W	230W	230W	450W	250W	250W
Parallel, serial, mouse ports	1, 2, 0	1, 1, 1	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0
EPP/ECP parallel interfaces supported	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Service and Support								
7-day, 24-hour five technical support	■	■	■	■	■	■	■	■
Standard warranty on parts/labor	1 year/1 year	1 year/1 year	1 year/1 year	1 year/1 year	3 years/1 year	3 years/1 year	3 years/3 years	3 years/3 years
On-site service charge (and term)	Included (1 year)	Included (1 year)	\$50 (1 year)	\$50 (1 year)	Included (1 year)	Included (1 year)	\$50 (1 year)	\$50 (1 year)
BCM—BCM Advanced Research, FCT—Free Computer Technology, FIC—First International Computer.								

Micron Computer Inc.

P75 PCI PowerStation

P100 Millennium

P120 Millennium



Micron Computer's technological prowess is clearly evident in the Micron P120 Millennium (\$3,799 and an Editors' Choice), P100 Millennium (\$3,299), and P75 PCI PowerStation (\$2,499). These machines

are all top-notch performers offered at an eminently reasonable cost.

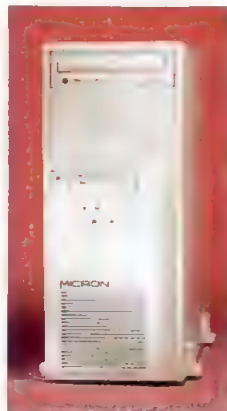
Millennia systems differ from PowerStations in their use of EDO DRAM and Micron's 10-ns SyncBurst cache. All three

ship with Microsoft Office Professional. Micron also sells a Magnum line of 486-based PCs to businesses and consumers and a Home MPC line to consumers (neither line is reviewed).

The PowerStation's Graphics WinMark 95 score helped the unit tie for second place in its CPU class. Its Disk WinMark 95 score was also above average, and its Winstone 95 score was average. On our Winstone tests, the P100 was topped by only a few other Pentium/100 units, and only then by a sliver. Its Disk WinMark and

Graphics WinMark scores were above average. The P120, another star performer on our Windows-based tests, garnered the highest Graphics WinMark score we've ever seen and also had a top-notch Winstone score.

On our latest Service & Reliability survey, Micron earned a Readers' Choice award.—CV
Micron Computer Inc., Nampa, ID; 800-388-6334, 208-463-3434; fax, 208-465-3424.
 Circle 494 on reader service card



Dell Dimension XPS P75	Dell Dimension XPS P90	Dell Dimension XPS P100	Dell Dimension XPS P120c	DFI Diamond P100	Diamond Thunder Power	Diamond Pentium Power Server	Digital Celebris 575	Digital Celebris XL 5100	DTK QUIN-35
\$2,632	\$3,147	\$3,537	\$4,249	\$3,399	\$2,595 (street)	\$2,995 (street)	\$4,021	\$4,497	\$2,250 (street)
Pentium/75	Pentium/90	Pentium/100	Pentium/120	Pentium/100	Pentium/75	Pentium/100	Pentium/75	Pentium/100	Pentium/75
16MB	16MB	16MB EDO	16MB EDO	16MB	16MB	16MB	16MB	16MB	16MB
1GB EIDE	1GB EIDE	1.5GB EIDE	1.5GB EIDE	1GB EIDE	539MB EIDE	1GB EIDE	515MB EIDE	1GB SCSI-2	1.2GB EIDE
Number Nine GXE64 (2MB)	Number Nine GXE64 Pro (2MB)	Number Nine 9FX Motion771 (2MB)	Number Nine Imagine 128 (4MB)	DFI WG-3000P2 (2MB)	ATI Graphics Pro Turbo (4MB)	ATI WinTurbo (2MB)	Integrated S3 Vision864 (1MB)	Diamond Stealth 64 (2MB)	Cardex Thunder64 Pro (2MB)
Dell UltraScan 15TE (15")	Dell UltraScan 17ES (17")	Dell UltraScan 17ES (17")	Dell UltraScan 17ES (17")	ADI MicroScan 5AP (17")	Impression 15NZ (15")	Impression 15NZ (15")	Digital VRT17-HA (17")	Digital VRT17-HA (17")	ADI SM-5515GP (15")
NEC CDR-271 (4x ATAPI)	NEC CDR-271 (4x ATAPI)	NEC CDR-271 (4x ATAPI)	NEC CDR-271 (4x ATAPI)	Mitsumi CRM-CFX400 (4x ATAPI)	Funai 2X (2x ATAPI)	Funai 2X (2x ATAPI)	Philips FRPCXCR-AH (2x ATAPI)	Toshiba XM-5201 (3x SCSI-2)	TEAC CD-55A SuperQuad (4x proprietary)
Creative Labs Sound Blaster 16	Creative Labs Sound Blaster 16	Creative Labs Sound Blaster 16	Creative Labs Sound Blaster 16	Oak Technology Mozart 16	Diamond Tech- nologies MF-009	Diamond Tech- nologies MF-009	Media Vision Jazz16	Ensoniq SoundScape	Creative Labs Sound Blaster 16
■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■
6.2, WinWg 3.11	6.2, WinWg 3.11	6.2, WinWg 3.11	6.2, WinWg 3.11	6.22, WinWg 3.11	6.22, WinWg 3.11	6.22, WinWg 3.11	6.22, WinWg 3.11	6.22, WinWg 3.11	6.22, Win 3.1
256K, 256K	256K, 256K	256K, 512K	256K, 512K	256K, 256K	256K, 1MB	256K, 1MB	256K, 512K	256K, 512K	256K, 1MB
Intel	Intel	Intel	Intel	Intel	Asustek	Asustek	Digital	Digital	DTK
Intel Neptune	Intel Neptune	Intel Triton	Intel Triton	Intel Neptune	SIS 85C501-03	SIS 85C501-03	VLSI 590	Intel Neptune	SIS 85C501-03
AMI (11/11/92)	AMI (11/11/92)	AMI (2/7/95)	AMI (2/7/95)	AMI (8/23/94)	Award (12/17/94)	Award (12/17/94)	Phoenix (12/14/94)	Phoenix Digital 1.01	Award 4.50G
■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
■	■	■	■	■	■	■	■	■	■
128MB	128MB	128MB	128MB	128MB	128MB	128MB	128MB	192MB	128MB
4 ISA, 2 PCI, 1 PCI/ISA	4 ISA, 2 PCI, 1 PCI/ISA	3 ISA, 3 PCI, 1 PCI/ISA	3 ISA, 3 PCI, 1 PCI/ISA	4 ISA, 2 PCI, 1 PCI/ISA	3 ISA, 3 PCI, 1 PCI/ISA	3 ISA, 3 PCI, 1 PCI/ISA	2 PCI/ISA	3 ISA, 2 PCI, 1 PCI/ISA	3 ISA, 3 PCI, 1 PCI/ISA
3, 1	3, 1	3, 1	3, 1	4, 1	3, 2	3, 2	1, 1	3, 1	4, 1
0, 2	0, 2	0, 2	0, 2	2, 1	0, 0	0, 2	0, 2	0, 1	0, 4
225W	200W	230W	230W	250W	230W	230W	100W	300W	250W
1, 2, 1	1, 2, 1	1, 2, 1	1, 2, 1	1, 2, 0	1, 2, 1	1, 2, 1	1, 2, 1	1, 2, 1	1, 2, 1
■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
■	■	■	■	■	■	■	■	■	■
1 year/1 year	1 year/1 year	1 year/1 year	1 year/1 year	2 years/Lifetime	3 years/3 years	3 years/3 years	3 years/3 years	3 years/3 years	2 years/2 years
Included (1 year)	Included (1 year)	Included (1 year)	Included (1 year)	\$58 (1 year)	\$30 (1 year)	\$30 (1 year)	Included (1 year)	Included (1 year)	\$50 (1 year)

MidWest Micro

P5-75 Office PC
P5-100 Office PC
P5-120 Office PC

MidWest Micro's \$2,999 P5-75, \$3,999 P5-100, and \$4,099 P5-120 Office PCs offer strong performance, quality components, and attractive prices. These units are sold direct.

The P5-120 came loaded with a NEC quad-speed CD-ROM drive, whereas the other two Office PCs used NEC double-speed drives (quad-speed drives are now standard). All three systems also included

Aztech WaveRider32+ sound cards, which support wavetable synthesis. All three PCs came with Altec Lansing speakers; the P5-100 and P5-120 also had subwoofers.

Internal 28.8-Kbps modems are bundled with two of these units (it's a \$149 option on the P5-120), and a 17-inch monitor comes with the P5-100 and P5-120. All three came preloaded with a great selection

of software, including Microsoft Bookshelf 94, Microsoft Encarta 95, and Microsoft Office Pro.

The P5-100 did very well on our Winstone 95 tests, producing a score that ranked in the top five of its CPU class. This unit also turned in above-average scores on our Disk WinMark 95 tests. The P5-120 was

very competitive within its tightly spaced CPU class; it and the P5-75 both had average scores on all tests.

These systems have three-year parts-and-labor warranties. MidWest Micro offers overnight replacement of any failed component for the warranty's duration.—CV

MidWest Micro, Fletcher, OH; 800-728-8582, 513-368-2309; fax, 800-562-6622.

Circle 495 on reader service card



IN SHORT	
<i>These PCs combine strong performance and great peripherals at a good price.</i>	
SERVICE & RELIABILITY	
Reliability	Average
Repair service	Average
Tech support	Average

POWER BITE OFF YOU CA



DELL DIMENSION XPS P100c A PENTIUM PROCESSOR-BASED 100MHz SYSTEM

\$2799 | BUSINESS LEASE*
\$104/Mo.

- MINI TOWER MODEL
- 16MB EDO MEMORY
- 1GB EIDE HARD DRIVE (10MS)
- 256KB WRITEBACK CACHE
- 15LS MONITOR (15" CRT, NII)
- 9FX MOTION PCI 2MB VRAM VIDEO CARD
- 4X MULTI-SESSION EIDE CD-ROM DRIVE
- ONE DISKETTE DRIVE (3.5")
- SPACESAVER KEYBOARD/MOUSE
- MS-DOS® 6.2/MICROSOFT® WINDOWS® 3.1/30 DAYS FREE SUPPORT

ORDER CODE #500090



DELL DIMENSION XPS P100c A PENTIUM PROCESSOR-BASED 100MHz SYSTEM

\$3749 | BUSINESS LEASE*
\$135/Mo.

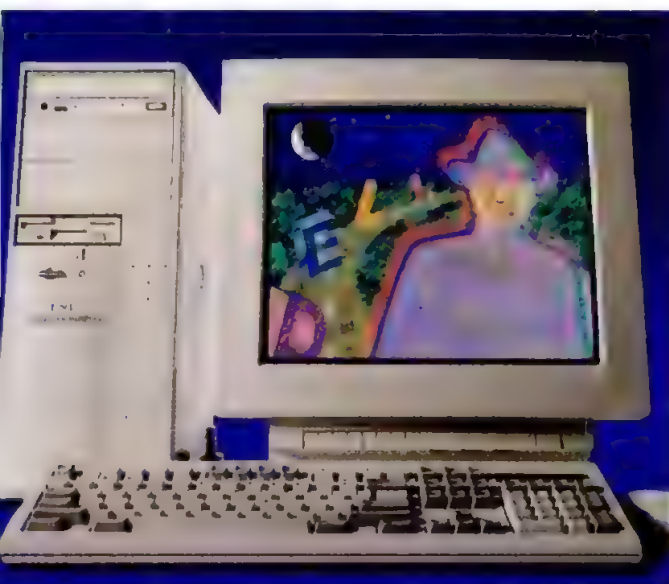
- MINI TOWER MODEL
- 16MB EDO MEMORY
- 1GB EIDE HARD DRIVE (10MS)
- 256KB WRITEBACK CACHE
- U17ES MONITOR (17" CRT, 1024x768 @ 78KHz)
- IMAGINE 128 GRAPHICS ACCELERATOR WITH 4MB VRAM
- 4X MULTI-SESSION EIDE CD-ROM DRIVE
- SOUND BLASTER 16 SOUND CARD
- ALTEC LANSING ACS-5 SPEAKERS
- ONE DISKETTE DRIVE (3.5")
- SPACESAVER KEYBOARD/MOUSE
- MS-DOS 6.2/MICROSOFT WINDOWS 3.1/30 DAYS FREE SUPPORT

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Ⓜ Denotes a feature which makes this system even more cool. *Business leasing arranged by Leasing Group, Inc. *Prices and specifications are valid in the U.S. only and are subject to change without notice. The Intel Inside logo and Pentium are registered trademarks of Intel Corporation. MS-DOS, Microsoft, MS and Windows are registered trademarks of Microsoft Corporation. ©1995 Dell Computer Corporation. All rights reserved.

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- MS® OFFICE 4.3, MS BOOKSHELF, VISIO EXPRESS FOR MS OFFICE
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DELL®

SUMMARY OF FEATURES

Pentium and Nx586 PCs



■ YES □ NO

Products listed in review order

	DTK QUIN-52	Duracom MiniPro Nx586-100	Ergo ThunderBrick 100+	Everex Step SP/75	Everex Step SP/100	Gateway P5-75	Gateway P5-100XL	Gateway P5-120
List price (tested configuration)	\$3,650 (street)	\$3,599	\$4,295	\$3,479	\$3,899	\$2,658	\$3,340	\$4,299
Processor	Pentium/100	Nx586-P100	Pentium/100	Pentium/75	Pentium/100	Pentium/75	Pentium/100	Pentium/120
Installed RAM	16MB	16MB	16MB EDO	16MB	16MB	16MB	16MB EDO	16MB EDO
Hard disk capacity and interface	1.2GB EIDE	1GB SCSI-2	1GB EIDE	472MB EIDE	1.2GB EIDE	696MB EIDE	1GB EIDE	1.5GB EIDE
Graphics adapter (and memory)	Cardex Thunder64 Pro	Number Nine GXE64 (2MB)	Diamond Stealth 64 (4MB)	FIC Trio64 (1MB)	FIC Trio64 (1MB)	ATI Graphics Xpression (2MB)	ATI Graphics Xpression (2MB)	ATI Graphics Xpression (2MB)
Monitor (and diagonal screen size)	ADI SM-5515GP (15")	ADI MicroScan 4GP (15")	Smile CA1718 (17")	TVM AS5G (15")	TVM AS6G (17")	Sony CPD-15F13 (15")	Sony CPD-15F13 (15")	Sony CPD-17F13 (17")
CD-ROM drive (and speed and interface)	TEAC CD-55A SuperQuad (4x proprietary)	Plextor 4Plex 4GP (15")	Toshiba XM-5302B (4x ATAPI)	TEAC CD-55A SuperQuad (4x proprietary)	TEAC CD-55A SuperQuad (4x proprietary)	Mitsumi CRM-C-FX400 (4x ATAPI)	Mitsumi CRM-C-FX400 (4x ATAPI)	Torisan CDR-C3G (4x ATAPI 3-CD changer)
Sound adapter	Creative Labs Sound Blaster 16	Aztech WaveRider 32+	Media Magic Roadrunner	Formosa Industrial Computing Strauss 16	Formosa Industrial Computing Strauss 16	Ensoniq SoundScape	Ensoniq SoundScape	Ensoniq SoundScape
Speakers/Network adapter/Modem included	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■
DOS, Windows version included	6.22, Win 3.1	6.22, WinWg 3.11	6.22, WinWg 3.11	6.22, WinWg 3.11	6.22, WinWg 3.11	6.22, WinWg 3.11	6.22, WinWg 3.11	6.22, WinWg 3.11
Motherboard Components								
Installed, maximum external RAM cache	256K, 512K	256K, 256K	256K, 256K	256K, 256K	256K, 256K	256K, 256K	256K, 256K	256K, 256K
Motherboard manufacturer	DTK	Alaris	Intel	FIC	FIC	Intel	Intel	Intel
Chip set manufacturer and model	Intel Neptune	NexGen NxVL	Intel Triton	Intel Neptune	Intel Neptune	Intel Neptune	Intel Triton	Intel Triton
BIOS manufacturer and version (or date)	Award ROM-EISA 2BS9AD111	AMI 005Q033S	AMI (1/12/95)	Award (12/14/94)	Award (12/14/95)	AMI 1.00.12, AX1T	AMI 0.10.01 BRO	AMI (2/10/95)
Flash BIOS/Plug and Play BIOS	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Multiprocessor socket	■	■	■	■	■	■	■	■
Expendability								
Maximum RAM	512MB	192MB	128MB	128MB	128MB	128MB	128MB	128MB
Expansion-bus slots	3 EISA, 2 PCI, 1 PCI/ISA	5 ISA, 2 VLB	2 ISA, 3 PCI, 1 PCI/ISA	3 ISA, 4 PCI	3 ISA, 4 PCI	4 ISA, 2 PCI, 1 PCI/ISA	2 ISA, 3 PCI, 1 PCI/ISA	3 ISA, 4 PCI
Accessible drive bays (5.25", 3.5")	4, 1	3, 3	3, 1	3, 2	3, 2	3, 1	4, 1	3, 1
Internal drive bays (5.25", 3.5")	0, 4	0, 0	0, 1	0, 3	0, 2	0, 2	0, 3	0, 3
Power-supply wattage	250W	220W	200W	200W	200W	145W	145W	230W
Parallel, serial, mouse ports	1, 2, 1	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 1	1, 2, 1	1, 2, 1
EPP/ECP parallel interfaces supported	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Service and Support								
7-day, 24-hour live technical support	■	■	■	■	■	■	■	■
Standard warranty on parts/labor	2 years/2 years	1 year/1 year	4 years/4 years	3 years/3 years	3 years/3 years	3 years/1 year	3 years/1 year	3 years/1 year
On-site service charge (and term)	\$50 (1 year)	Included (1 year)	Included (4 years)	Included (1 year)	Included (1 year)	Included (1 year)	Included (1 year)	Included (1 year)

BCM—BCM Advanced Research, FCT—Free Computer Technology, FIC—First International Computer

Mitac Corp.

Mitac Performance 75

Mitac Performance 100

The \$2,899 Mitac Performance 100 and the \$2,399 Mitac Performance 75 represent Mitac Corp.'s PCs for the home market (sold through resellers). Though both are reasonable values and were among the few in this roundup to include 14.4-Kbps modems and a great software bundle, neither machine did very well on our benchmark tests and both suffered from some design oversights.

The two units came in identical mini-tower cases that had only one drive bay free. Though I/O ports were integrated on the motherboard, both units ran their ports out through the back of one of the three PCI

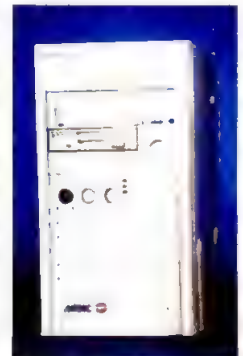
slots. In the Pentium/75-based Performance 75, that meant no PCI slots were readily available, because the Diamond Telemetry 32 sound card (used in both machines) occupied the shared ISA/PCI slot and the other was taken by a Diamond Stealth 64 card (also used in both). Mitac avoided this in the Pentium/100-based Performance 100 by placing its sound card in one of the other ISA slots.

A below-average score on our Disk WinMark 95 tests hurt the Performance 75 and led to a below-average Winstone 95 score. Its Graphics WinMark 95 score was average for its CPU group.

The Performance 100 was not able to

run with Windows for Workgroups' 32-bit file cache enabled, and as a result this system fared even worse than the Performance 75. The machine's Winstone score was below that of the Performance 75, and the rest of the Performance 100's scores — though higher than those of its sibling — were below average for its CPU group.—Amush Yeghazarian
Mitac Corp., Fremont, CA; 800-285-9874; fax, 510-440-3604.

Circle 496 on reader service card



GST Apogee PT75	GST Apogee PT100	Hertz P75e	Hertz P100e	HR P5-75 Tower	HR P5-100 Tower	HP Vectra VL 5/75	HP Vectra VL 5/90	HP Vectra VL 5/120	HP Vectra XU 5/100C
\$2,799 (street)	\$3,299 (street)	\$2,645	\$2,995	\$2,799 (street)	\$3,499 (street)	\$2,923	\$3,310	\$4,280	\$5,625
Pentium/75	Pentium/100	Pentium/75	Pentium/100	Pentium/75	Pentium/100	Pentium/75	Pentium/90	Pentium/120	Pentium/100
16MB	16MB	16MB	16MB EDO	16MB	16MB	16MB	16MB	16MB	16MB
896MB EIDE	1GB EIDE	515MB EIDE	1GB Fast ATA	687MB Fast ATA	1GB Fast ATA	813MB SCSI-2	813MB EIDE	1GB EIDE	1GB SCSI-2
Diamond Stealth 64 (2MB)	Diamond Stealth 64 (2MB)	ATI Graphics Xpression (2MB)	ATI WinTurbo (2MB)	Diamond Stealth 64 (2MB)	Diamond Stealth 64 (2MB)	Integrated CL-GD5434 (1MB)	Integrated CL-GD5434 (1MB)	Integrated CL-GD5434 (2MB)	Matrox MGA Impression+ (4MB)
Proton GM-1563M (15")	Proton GM-1563M (15")	MAG DX15F (15")	MAG DX15F (15")	MAG MX15F (15")	MAG MX15F (15")	HP D2807A (17")	HP D2807A (17")	HP D2807A (17")	HP D2807A (17")
TEAC CD-55A SuperQuad (4x proprietary)	Toshiba XM-3501B (4x SCSI-2)	Panasonic CR-562-B (2x proprietary)	Panasonic CR-562-J (2x proprietary)	Toshiba XM-3501B (4x SCSI-2)	Toshiba XM-3501B (4x SCSI-2)	Sony CDU-550 (2x ATAPI)	Sony CDU-550 (2x ATAPI)	Sony CDU-550 (2x ATAPI)	Toshiba XM-4101B (2x SCSI-2)
Creative Labs Sound Blaster Pro	Creative Labs Sound Blaster 16 SCSI-2	Creative Labs Sound Blaster 16	Creative Labs Sound Blaster 16	Creative Labs Sound Blaster 16 SCSI-2	Creative Labs Sound Blaster 16 SCSI-2	None	None	Cardinal Digital Sound 16	Cardinal Digital Sound 16
■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■
6.22, WWG 3.11	6.22, WWG 3.11	6.22, WWG 3.11	6.22, WWG 3.11	6.22, WWG 3.11	6.22, WWG 3.11	6.22, WWG 3.11	6.22, WWG 3.11	6.22, WWG 3.11	6.22, WWG 3.11
256K, 512K	256K, 1MB	512K, 512K	256K, 512K	256K, 256K	256K, 256K	256K, 256K	256K, 256K	256K, 256K	512K, 512K
Micronics	GST	Hertz	Hertz	Intel	Intel	HP	HP	HP	HP
Intel Neptune	SIS 85C501-03	SIS 85C501-03	Intel Triton	Intel Neptune	Intel Neptune	VLSI 82C591-93	VLSI 82C591-93	VLSI 82C591-93	Intel Neptune
Phoenix 4.02	Award (10/27/94)	Award (12/17/94)	Award (1/10/95)	AMI (11/30/94)	AMI (11/30/94)	Phoenix GK.05.00	Phoenix GK.05.00	Phoenix (2/28/95)	HP (12/02/94)
■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
■	■	■	■	■	■	■	■	■	■
192MB	128MB	128MB	128MB	128MB	128MB	192MB	192MB	192MB	128MB
4 ISA, 2 PCI, 1 PCI/ISA	3 ISA, 3 PCI, 1 PCI/ISA	3 ISA, 3 PCI, 1 PCI/ISA	3 ISA, 3 PCI, 1 PCI/ISA	3 ISA, 2 PCI, 1 PCI/ISA	4 ISA, 2 PCI, 1 PCI/ISA	3 ISA, 2 PCI	3 ISA, 2 PCI	2 ISA, 1 PCI, 1 PCI/ISA	3 ISA, 1 PCI, 1 PCI/ISA
4, 0	4, 1	4, 1	4, 1	3, 2	3, 2	2, 0	2, 0	1, 1	2, 1
2, 2	2, 2	0, 4	0, 4	0, 3	0, 3	0, 2	0, 2	0, 1	0, 1
250W	250W	250W	250W	200W	200W	100W	100W	100W	160W
1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 1	1, 2, 0	1, 2, 1	1, 1, 1
■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
■	■	■	■	■	■	■	■	■	■
1 year/1 year	1 year/1 year	1 year/1 year	1 year/1 year	2 years/2 years	2 years/2 years	3 years/3 years	3 years/3 years	3 years/3 years	3 years/3 years
\$94 (3 years)	\$104 (3 years)	\$495 (1 year)	\$495 (1 year)	\$30 (1 year)	\$30 (1 year)	Included (1 year)	Included (1 year)	Included (1 year)	Included (1 year)

National MicroComputers Inc. NMC Expert-System

National MicroComputers' NMC Expert-System, based on a Pentium/75 processor, combines a reasonable \$2,593 price with average Windows performance. NMC aims this PCI/ISA-based system at the entry-level home and business multimedia user. The company also markets an NMC Basic line, which consists of general-purpose 486-based systems, as well as the midrange NMC Pro line, with DX4 processors and either PCI or VL-Bus expansion slots (neither is reviewed here).

This system includes all the basics for

multimedia, such as a quad-speed CD-ROM drive, a 16-bit LaserWave Futura16 sound card with FM and wavetable synthesis capability and Sound Blaster compatibility, and standard external speakers. To help beginners, the company bundles a CD-ROM-based Windows tutorial with the unit. By the time you read this, NMC will be shipping systems powered by Intel's Triton chip set.

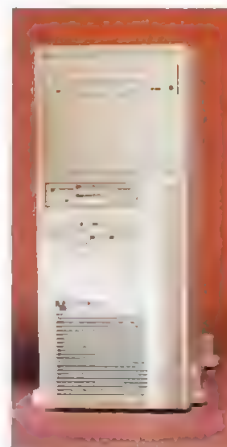
On our Winstone 95 tests, the Expert-System's score was average, as was its Graphics WinMark 95 score. This unit used a Cardex Power 64 Pro graphics accelerator powered by S3's Vision864 chip set and 2MB of DRAM. The system's average Disk WinMark 95 score—achieved with the

aid of a 687MB Seagate hard disk and integrated PCI controller—also helped its Winstone results.

NMC includes a three-year warranty with the NMC Expert-System, with on-site service available as a \$65 option for the first year.—AY

National MicroComputers Inc., Murray, UT; 800-800-4662, 801-265-3700; fax, 801-265-3783.

Circle 497 on reader service card



SUMMARY OF FEATURES

Pentium and Nx586 PCs

■ YES ■ NO

Products listed in review order

	IBM PC 750-P90	Insight PCI P75 MM	Insight PCI P100 MM	Insight PCI P120 MM	Inteleco Star 75	Maximus Magna Media	Maximus Magna Graphics Media	Maximus Winmax96 Nx586
List price (tested configuration)	\$8,084	\$3,299	\$4,199	\$4,499	\$2,499	\$2,195	\$3,295	\$2,195
Processor	Pentium/90	Pentium/75	Pentium/100	Pentium/120	Pentium/75	Pentium/75	Pentium/100	Nx586-P90
Installed RAM	16MB	16MB	16MB	16MB EDO	16MB	16MB	16MB	16MB
Hard disk capacity and interface	1GB EIDE	850MB Fast ATA	1GB Fast ATA	1GB Fast ATA	687MB Fast ATA	812MB EIDE	1GB Fast ATA	812MB EIDE
Graphics adapter (and memory)	Integrated S3 Vision894 (2MB)	Diamond Stealth 64 (2MB)	Diamond Stealth 64 (4MB)	Diamond Stealth 64 (4MB)	Diamond Stealth 64 (1MB)	ATI WinTurbo (2MB)	ATI WinTurbo (2MB)	ATI Graphics Xpression (2MB)
Monitor (and diagonal screen size)	IBM 17P (17")	MAG DX17F (17")	IDEX Vision Master MF-8617 (17")	IDEX Vision Master MF-8617 (17")	Pacom KCS1E (15")	CTX 1562GM (15")	MAG DX17F (17")	CTX 1562GM (15")
CD-ROM drive (and speed and interface)	Mitsumi IBM-FXN01DE (2x ATAPI)	Mitsumi CRMC-FX400 (4x ATAPI)	Mitsumi CRMC-FX400 (4x ATAPI)	Mitsumi CRMC-FX400 (4x ATAPI)	TEAC CD-55A SuperQuad (4x proprietary)	Mitsumi CRMC-FX400 (4x ATAPI)	Mitsumi CRMC-FX400 (4x ATAPI)	Mitsumi CRMC-FX400 (4x ATAPI)
Sound adapter	Integrated Crystal CS4231	Diamond Sound Card	Integrated Crystal CS4232	Integrated Crystal CS4232	Boca Research Sound Expression 14.4 VSP	Creative Labs Sound Blaster 16	Creative Labs Sound Blaster AWE32	Creative Labs Sound Blaster 16
Speakers/Network adapter/Modem included	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■
DOS, Windows version included	IBM PC DOS 6.3, WinWg 3.11	6.22, WinWg 3.11	6.22, WinWg 3.11	6.22, WinWg 3.11	6.22, WinWg 3.11	6.2, WinWg 3.11	6.2, WinWg 3.11	6.2, WinWg 3.11
Motherboard Components								
Installed, maximum external RAM cache	256K, 1MB	256K, 256K	256K, 256K	256K, 256K	256K, 256K	256K, 256K	512K, 1MB	256K, 256K
Motherboard manufacturer	IBM	Intel	Intel	Intel	Intel	Diamond	Diamond	Alaris
Chip set manufacturer and model	VLSI 82C591-83	Intel Neptune	Intel Triton	Intel Triton	Intel Neptune	SIS 85C501-03	SIS 85C501-03	NexGen NxVL
BIOS manufacturer and version (or date)	IBM (12/14/92)	AMI 12	AMI (1/12/95)	AMI (10/12/95)	AMI 1.00.12.AX1	AMI 4.50G	AMI 4.50	AMI (11/11/92)
Flash BIOS/Plug and Play BIOS	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Multiprocessor socket	■	■	■	■	■	■	■	■
Expandability								
Maximum RAM	192MB	128MB	128MB	128MB	128MB	128MB	128MB	192MB
Expansion-bus slots	3 ISA, 2 PCI/ISA	4 ISA, 2 PCI, 1 PCI/ISA	2 ISA, 3 PCI, 1 PCI/ISA	2 ISA, 3 PCI, 1 PCI/ISA	4 ISA, 2 PCI, 1 PCI/ISA	4 ISA, 4 PCI	4 ISA, 4 PCI	5 ISA, 2 VLB
Accessible drive bays (5.25", 3.5")	2, 1	6, 0	4, 1	4, 1	0, 2	3, 2	5, 2	3, 2
Internal drive bays (5.25", 3.5")	0, 2	0, 4	0, 9	0, 9	1, 2	0, 3	0, 3	0, 2
Power-supply wattage	200W	250W	250W	250W	250W	230W	300W	230W
Parallel, serial, mouse ports	1, 2, 1	1, 2, 0	1, 2, 1	1, 2, 1	1, 2, 0	1, 2, 1	1, 2, 1	1, 2, 0
EPP/ECP parallel interfaces supported	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Service and Support								
7-day, 24-hour live technical support	■	■	■	■	■	■	■	■
Standard warranty on parts/labor	3 years/3 years	3 years/1 year	3 years/1 year	3 years/1 year	1 year/3 years	1 year/Lifetime	1 year/Lifetime	1 year/Lifetime
On-site service charge (and term)	Included (1 year)	N/A	N/A	N/A	Included (1 year)	\$45 (1 year)	\$45 (1 year)	\$45 (1 year)

N/A—Not applicable. The product does not have this feature. BCM—BCM Advanced Research, FCT—Free Computer Technology, PIC—First International Computer.

NEC Technologies Inc.

NEC PowerMate VP75

The \$2,929 NEC PowerMate VP75 aims to combine value and performance (hence the VP in its name) in a multimedia-capable corporate workstation. NEC Technologies also markets an entry-level 486 line, the PowerMate V series, and the higher-end Image line of business-oriented Pentium/90 and Pentium/100 PCs. For consumers, NEC offers the Ready line, which sells in the retail channel. (None of these alternative lines are reviewed here.) NEC does not bundle monitors with its systems; the price quoted includes the 15-

inch NEC MultiSync XV display, available separately for \$460.

Unlike some vendors, NEC has opted to evangelize multimedia in business. The PowerMate's no-tools mini-tower case contains a solid complement of multimedia hardware. Our test unit had a quad-speed Mitsumi IDE CD-ROM drive; NEC says it now bundles its own quad-speed drives.

IN SHORT

NEC offers solid performance with these business-oriented multimedia systems.

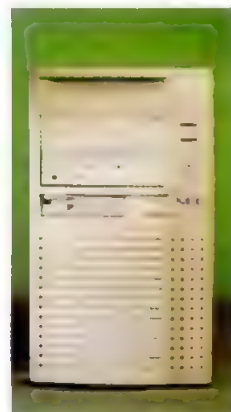
SERVICE & RELIABILITY

Reliability	Average
Repair service	Average
Tech support	Average

The system included a Creative Labs Vibra 16 sound card, which is Sound Blaster-compatible and supports FM synthesis. (A third-party wavetable-synthesis upgrade is available for under \$100.) It also came with better-than-average Altec Lansing ACS5 speakers.

The PowerMate's test results were average for a Pentium/75.

NEC has an impressive service-and-support plan: 24-hour, 7-day technical support, plus three years of standard service, which includes on-site service for the first year. A \$99 fee extends on-site coverage for two additional years.—AY
NEC Technologies Inc., Boxborough, MA; 800-632-4636, 508-264-8000.
 Circle 498 on reader service card



PC MAGAZINE
EDITOR'S CHOICE

Maximus Musicmax Nx586	Mega Impact Pentium 100	Micro Express MicroFLEX- PC/F75	Micro P75 PCI PowerStation	Micro P100 Millennia	Micro P120 Millennia	MidWest Micro P5-75 Office PC	MidWest Micro P5-100 Office PC	Midwest Micro P5-120 Office PC
\$3,195	\$2,999	\$2,499	\$2,499	\$3,299	\$3,799	\$2,999	\$3,999	\$4,099
Nx586-P100	Pentium/100	Pentium/75	Pentium/75	Pentium/100	Pentium/120	Pentium/75	Pentium/100	Pentium/120
16MB	16MB	16MB	16MB	16MB EDO	16MB EDO	16MB	16MB	16MB EDO
1GB Fast ATA	1GB EIDE	515MB EIDE	812MB EIDE	1.2GB EIDE	1.2GB EIDE	813MB EIDE	1GB EIDE	1GB EIDE
ATI Graphics Xpression (2MB)	ATI Graphics Xpression (2MB)	ATI WinTurbo (2MB)	Diamond Stealth 64 (2MB)	Diamond Stealth 64 (2MB)	Diamond Stealth 64 (2MB)	ATI Graphics Xpression (2MB)	ATI WinTurbo (2MB)	ATI Graphic Xpression (2MB)
MAG DX17F (17")	MGC 1588e (15")	Micro Express EM-590 (15")	ADI MicroScan 4V (15")	ADI MicroScan 4V (15")	ADI MicroScan 4V (15")	MidWest Micro Elite SRC1502 (15")	MidWest Micro Elite SRC1702 (17")	MidWest Micro Elite SRC1702 (17")
Mitsumi CRMC-FX400 (4x ATAPI)	Sony CDU-55E (2x ATAPI)	Toshiba XM- 3501B (4x SCSI-2)	Sony CDU-76E (4x ATAPI)	Sony CDU-76E (4x ATAPI)	Sony CDU-76E (4x ATAPI)	NEC CDR-216 (2x ATAPI)	NEC CDR-216 (2x ATAPI)	NEC CDR-271 (4x ATAPI)
Creative Labs Sound Blaster AWE32	Creative Labs Sound Blaster 16	Creative Labs Sound Blaster 16	Creative Labs Vibra 16	Creative Labs Vibra 16	Creative Labs Vibra 16	Aztech WaveRider 32+	Aztech WaveRider 32+	Aztech WaveRider 32+
■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■
6.2, WWG 3.11	6.22, WWG 3.11	6.22, Win 3.11	6.22, WWG 3.11	6.22, WWG 3.11	6.22, WWG 3.11	6.22, WWG 3.11	6.22, WWG 3.11	6.22, WWG 3.11
256K, 256K	1MB, 1MB	256K, 512K	256K, 512K	256K, 256K	256K, 256K	256K, 256K	256K, 256K	256K, 256K
Alaris	BCM	Micro Express	Micronix	Micronix	Micronix	Intel	Intel	Intel
NexGen NxVL	SIS 85C501-03	SIS 85C501-03	VLSI 590P	Intel Triton	Intel Triton	Intel Neptune	Intel Triton	Intel Triton
AMI (11/11/92)	Phoenix 4.04	Phoenix 4.04	Phoenix (1/5/95)	Phoenix (1/16/95)	Phoenix (2/24/95)	AMI 1.00.17	AMI (1/12/95)	AMI (1/12/95)
■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
■	■	■	■	■	■	■	■	■
192MB *	128MB	128MB	128MB	128MB	128MB	128MB	128MB	128MB
5 ISA, 2 VLB	3 ISA, 3 PCI, 1 PCI/ISA	3 ISA, 3 PCI, 1 PCI/ISA	5 ISA, 2 PCI, 1 PCI/ISA	3 ISA, 3 PCI, 1 PCI/ISA	3 ISA, 3 PCI, 1 PCI/ISA	4 ISA, 2 PCI, 1 PCI/ISA	2 ISA, 3 PCI, 1 PCI/ISA	2 ISA, 3 PCI, 1 PCI/ISA
5, 2	4, 1	3, 2	3, 1	3, 1	3, 1	5, 1	5, 1	5, 1
0, 1	0, 4	0, 1	0, 2	0, 2	0, 2	0, 4	0, 5	0, 5
300W	250W	230W	200W	200W	200W	260W	230W	230W
1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 1	1, 2, 1	1, 2, 1	1, 2, 0	1, 2, 0	1, 2, 0
■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
■	■	■	■	■	■	■	■	■
1 year/Lifetime	1 year/1 year	2 years/2 years	1 year/1 year	1 year/1 year	1 year/1 year	3 years/3 years	3 years/3 years	3 years/3 years
\$45 (1 year)	N/A	\$50 (1 year)	Included (1 year)	Included (1 year)	Included (1 year)	N/A	N/A	N/A

Polywell Computers Inc.

Poly 575IP

Poly 5100D2

Polywell Computers sent us the \$2,338 Pentium/75-based Poly 575IP and the \$4,250 Pentium/100-based Poly 5100D2. Both were average performers. The Poly 575IP and its multimedia software bundle are targeted toward home users, while the Poly 5100D2 is aimed at the corporate high-end workstation market.

The Poly 5100D2 is the more interesting of the two. It came with a quad-speed CD-ROM drive and a dual-processor-capable motherboard. Its 17-inch monitor easily outdoes the

Poly 575IP's 15-inch display. Even value-conscious buyers might find the extra \$300 worthwhile, since the 15-inch monitor cannot handle 800-by-600 resolution at 72 Hz.

On our Windows-based tests, the Poly 5100D2—using a 1GB hard disk with a 4MB caching controller and a Diamond Stealth 64 VRAM-based graphics card—managed to post average scores.

The Poly 575IP, which is housed in a mini-tower case, offers a good software bundle. Among the offerings are Kai's Power Tools, Grolier's Encyclopedia, and several games. It also came with a double-speed CD-ROM drive, a Sound Blaster 16 card, Creative Labs external speakers, and

a full-size microphone.

The Poly 575IP—using a DRAM-based graphics card—posted average scores on our Winstone 95 and Graphics WinMark 95 tests. But the Poly 575IP could not match the rest of its CPU group on our disk tests.—AY

Polywell Computers Inc., So. San Francisco, CA; 800-999-1278, 415-583-7222; fax, 415-583-1974.

Circle 499 on reader service card



IN SHORT
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highlights these
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#656354 Monitor sold separately

\$1,999⁹⁹

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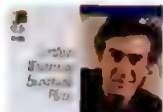
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Compudyne 15" 28 NI Monitor #289690 \$299.99

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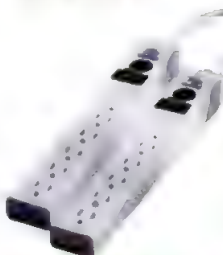
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SUMMARY OF FEATURES

Pentium and Nx586 PCs

	Mitac Performance 75	Mitac Performance 100	NMC Expert-System	NEC PowerMate VP75	Polywell Poly 575IP	Polywell Poly 51002	Reason Square 5-LXP/IP-75	Reason Square 5-LXP/IP-100
■ YES ■ NO								
Products listed in review order								
List price (tested configuration)	\$2,399	\$2,899	\$2,593	\$2,929	\$2,338	\$4,250	\$2,495	\$4,895
Processor	Pentium/75	Pentium/100	Pentium/75	Pentium/75	Pentium/75	Pentium/100	Pentium/75	Pentium/100
Installed RAM	16MB	16MB	16MB	16MB	16MB	16MB	16MB	16MB
Hard disk capacity and interface	812MB EIDE	1.2GB EIDE	887MB Fast ATA	773MB EIDE	504MB EIDE	1GB EIDE	1GB EIDE	1.7GB SCSI-2
Graphics adapter (and memory)	Diamond Stealth 64 (2MB)	Diamond Stealth 64 (2MB)	Cardex Technology Power 64 Pro (2MB)	Integrated CL-GD5434 (1MB)	Diamond Stealth 64 (2MB)	Diamond Stealth 64 (2MB)	Diamond Stealth 64 (2MB)	Number Nine Imagine 128 (4MB)
Monitor (and diagonal screen size)	Mitac L1550PD-01U (15")	Mitac L1564PD (15")	ADI MicroScan 4GP (15")	NEC MultiSync XV15 (15")	Socos DCM-1488 (15")	Sampo KDM-1767E (17")	Sony CPD-15SF1 (15")	Nokia Multigraph 447X (17")
CD-ROM drive (and speed and interface)	TEAC CD-55A SuperQuad (4x proprietary)	TEAC CD-55A SuperQuad (4x proprietary)	TEAC CD-55A SuperQuad (4x proprietary)	Mitsumi CRMC-FX400 (4x ATAPI)	Panasonic CR-563-B (2x proprietary)	TEAC CD-55A SuperQuad (4x proprietary)	Mitsumi CRMC-FX400 (4x ATAPI)	Toshiba XM-3501B (4x SCSI-2)
Sound adapter	Diamond Sound Card	Diamond Sound Card	LaserWave Futura 16	Creative Labs Vibra 16	Creative Labs Sound Blaster 16	Creative Labs Sound Blaster 16 MCD	Turtle Beach Monte Carlo	Turtle Beach Tropez
Speakers/Network adapter/Modem included	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■
DOS, Windows version included	6.22, WinWg 3.11	6.22, WinWg 3.11	6.22, WinWg 3.11	6.22, WinWg 3.11	6.22, WinWg 3.11	6.22, WinWg 3.11	6.22, WinWg 3.11	6.22, WinWg 3.11
Motherboard Components								
Installed, maximum external RAM cache	256K, 1MB	256K, 1MB	256K, 1MB	256K, 256K	256K, 256K	256K, 512K	256K, 256K	256K, 256K
Motherboard manufacturer	Mitac	Mitac	Elitegroup	NEC	Intel	Asustek	Intel	Intel
Chip set manufacturer and model	SIS 85C501-03	SIS 85C501-03	SIS 85C501-03	SIS 85C501-03	Intel Neptune	Intel Neptune	Intel Neptune	Intel Neptune
BIOS manufacturer and version (or date)	AMI (7/25/94)	AMI (7/25/94)	Phoenix (12/16/94)	Phoenix (1/30/95)	AMI (8/23/94)	Award (11/15/94)	AMI 9	AMI 10
Flash BIOS/Plug and Play BIOS	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Multiprocessor socket	■	■	■	■	■	■	■	■
Expandability								
Maximum RAM	128MB	128MB	128MB	128MB	128MB	512MB	128MB	128MB
Expansion-bus slots	3 ISA, 2 PCI, 1 PCI/ISA	3 ISA, 2 PCI, 1 PCI/ISA	3 ISA, 3 PCI, 1 PCI/ISA	3 ISA, 1 PCI, 1 PCI/ISA	4 ISA, 2 PCI, 1 PCI/ISA	3 ISA, 3 PCI, 1 PCI/ISA	4 ISA, 2 PCI, 1 PCI/ISA	4 ISA, 2 PCI, 1 PCI/ISA
Accessible drive bays (5.25", 3.5")	2, 2	2, 2	3, 1	3, 1	3, 2	8, 0	3, 1	3, 1
Internal drive bays (5.25", 3.5")	0, 0	0, 0	0, 2	0, 2	0, 2	2, 0	0, 3	0, 0
Power-supply wattage	230W	230W	200W	200W	230W	250W	200W	200W
Parallel, serial, mouse ports	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 1	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0
EPP/ECP parallel interfaces supported	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Service and Support								
7-day, 24-hour live technical support	■	■	■	■	■	■	■	■
Standard warranty on parts/labor	1 year/1 year	1 year/1 year	3 years/3 years	3 years/3 years	3 years/5 years	3 years/5 years	6 years/6 years	6 years/6 years
On-site service charge (and term)	Included (1 year)	Included (1 year)	\$85 (1 year)	Included (1 year)	\$75 (1 year)	\$75 (1 year)	Varies	Varies

BCM—BCM Advanced Research, FCT—Free Computer Technology, FIC—First International Computer.

Reason Technology

Square 5-LXP/IP-75
Square 5-LXP/IP-100

Reason Technology sent two units for this roundup: the \$2,495 Square 5-LXP/IP-75, equipped with a Pentium/75 CPU, and the \$4,895 Square 5-LXP/IP-100, which used a Pentium/100. The Square 5-LXP/IP-100's price includes a 17-inch monitor, a high-end sound card, and external speakers with a subwoofer. Both were mainly average performers.

Reason aims these systems at business users interested in multimedia. But their components point more toward a home office than a corporate office. Both units came with

high-end, 16-bit Turtle Beach sound cards, each capable of FM and wavetable synthesis. The Square 5-LXP/IP-75 used a Monte Carlo card, while the Square 5-LXP/IP-100 came with a Tropez card. Both systems used quad-speed CD-ROM drives, and both came with better-than-average speakers. The Square 5-LXP/IP-75 had Yamaha SBS300 speakers; the Square 5-LXP/IP-100 used Altec Lansing ACS3 multimedia speakers with an included subwoofer.

The Square 5-LXP IP-75 posted average test scores, while the Square 5-LXP IP-100, using a 128-bit Number Nine graphics card, posted average Winstone 95 and Graphics WinMark 95 scores

but a below-average Disk WinMark 95 score. The combination of its Fast/Wide SCSI-2 hard disk with an Adaptec SCSI controller kept it from matching the disk performance of the other 100-MHz units here,

most of which used Enhanced IDE hard disks.—AY

Reason Technology, Minneapolis, MN;
800-800-4860, 612-780-4792; fax, 612-780-4797.

Circle 500 on reader service card



IN SHORT

Top multimedia components and good prices earmark these PCs for a home office.

Robotech Cobra RSp100 Graphics Workstation	Summit Mount Brooks	Summit Mount McKinley	Sys Performance P100T	Tagram Thunderbolt P75	Tagram Thunderbolt P100	Tangent PCI-575	Tangent PCI-5100	Tangent NX5-P80	Tangent NX5-P100
\$4,099	\$2,995	\$3,640	\$4,199	\$2,195	\$2,845	\$2,475	\$2,995	\$2,250	\$2,750
Pentium/100	Pentium/75	Pentium/100	Pentium/100	Pentium/75	Pentium/100	Pentium/75	Pentium/100	Nx586-P80	Nx586-P100
16MB	16MB	16MB	16MB	16MB	16MB	16MB	16MB	16MB	16MB
1GB EIDE	506MB EIDE	1GB Fast ATA	1GB EIDE	504MB EIDE	1GB EIDE	540MB EIDE	1GB EIDE	504MB EIDE	1GB EIDE
Genoa Phantom 64 (2MB)	ATI WinTurbo (2MB)	ATI Graphics Xpression (2MB)	ATI Graphics Xpression (2MB)	Diamond Stealth 64 (2MB)	Diamond Stealth 64 (2MB)	Diamond Stealth 64 (2MB)	Diamond Stealth 64 (2MB)	Diamond Stealth 64 (2MB)	Diamond Stealth 64 (2MB)
IDEK Vision Master MF-8617 (17")	ViewSonic 15E (15")	ADI MicroScan 5EP (17")	Nokia Multigraph 447X (17")	Optquest 2000DX (15")	Optquest 2000DX (15")	CTX 1560LR (15")	CTX 1560LR (15")	CTX 1560LR (15")	CTX 1560LR (15")
TEAC CD-55A SuperQuad (4x proprietary)	Panasonic CR-562-J (2x proprietary)	Mitsumi CRMC-FX400 (4x ATAPI)	Toshiba XM-3501B (4x SCSI-2)	Panasonic CR-562-B (2x proprietary)	TEAC CD-55A SuperQuad (4x proprietary)	Sony CDU-55E (2x ATAPI)	TEAC CD-55A SuperQuad (4x proprietary)	Sony CDU-55E (2x ATAPI)	Sony CDU-55E (2x ATAPI)
Creative Labs Sound Blaster 16	Creative Labs Sound Blaster 16	Creative Labs Sound Blaster 16	Creative Labs Sound Blaster 16 SCSI-2	Diamond Sound Card	Diamond Sound Card	Oak Technology Mozart 16	Oak Technology Mozart 16	Oak Technology Mozart 16	Oak Technology Mozart 16
■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■
6.22, WfWg 3.11	6.22, WfWg 3.11	6.22, WfWg 3.11	6.22, WfWg 3.11	6.22, WfWg 3.11	6.22, WfWg 3.11	6.22, WfWg 3.11	6.22, WfWg 3.11	6.22, WfWg 3.11	6.22, WfWg 3.11
256K, 256K	256K, 512K	256K, 512K	256K, 256K	1MB, 1MB	1MB, 1MB	256K, 256K	256K, 256K	256K, 256K	256K, 256K
Intel	Asustek	Asustek	Super Micro	BCM	BCM	FIC	FIC	Alaris	Alaris
Intel Neptune	SIS 85C501-03	Intel Triton	Intel Triton	SIS 85C501-03	SIS 85C501-03	Intel Neptune	Intel Neptune	NexGen NxVL	NexGen NxVL
AMI 1.00.10.AX1	Award (1/10/95)	Award (1/10/95)	AMI (10/10/94)	Phoenix 4.04	Phoenix 4.04	AMI (12/14/94)	AMI (12/14/94)	Award (11/11/92)	Award (11/11/92)
■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
■	■	■	■	■	■	■	■	■	■
128MB	128MB	128MB	128MB	128MB	128MB	192MB	192MB	128MB	128MB
3 ISA, 2 PCI, 1 PCI/ISA	3 ISA, 3 PCI, 1 PCI/ISA	3 ISA, 3 PCI, 1 PCI/ISA	3 ISA, 3 PCI, 1 PCI/ISA	3 ISA, 3 PCI, 1 PCI/ISA	3 ISA, 3 PCI, 1 PCI/ISA	3 ISA, 4 PCI	3 ISA, 4 PCI	5 ISA, 2 VLB	5 ISA, 2 VLB
4, 1	3, 2	3, 1	6, 1	2, 2	3, 2	3, 2	3, 0	3, 2	3, 0
0, 4	0, 1	0, 1	0, 3	0, 1	0, 2	0, 0	0, 2	0, 0	0, 2
230W	250W	230W	250W	200W	200W	200W	200W	200W	200W
1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 1	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0
■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
■	■	■	■	■	■	■	■	■	■
2 years/Lifetime	1 year/1 year	1 year/1 year	1 year/1 year	3 years/3 years	3 years/3 years	1 year/1 year	1 year/1 year	1 year/1 year	1 year/1 year
Included (1 year)	\$55 (1 year)	\$55 (1 year)	\$49 (1 year)	\$50 (1 year)	\$50 (1 year)	Included (1 year)	Included (1 year)	Included (1 year)	Included (1 year)

Robotech Inc.

Cobra RSp100 Graphics Workstation

Robotech's /100-based Cobra RSp100 Graphics Workstation combines good performance with an exceptional software bundle and an MPEG-capable video board—all for \$4,099.

The reason that the system's price is a good deal higher than average is because of the unit's extra components. Take away the MPEG board and software bundle and its price tag compares with that of a more typically configured machine.

The Cobra RSp100 Graphics Workstation is meant to be a multimedia PC

for business, home, or educational use. To that end, Robotech includes a 17-inch monitor, a quad-speed CD-ROM drive, and a Sigma auxiliary video board capable of MPEG video playback. Preloaded software includes Novell's Perfect Office and Compton's MPEG Encyclopedia.

IN SHORT

The Cobra comes with multimedia extras for the home.

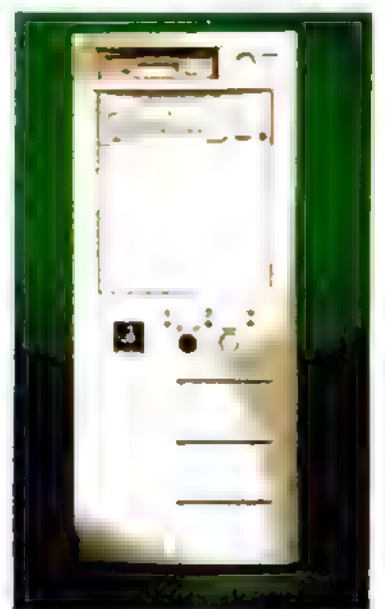
The Cobra RSp100 Graphics Workstation's performance on our benchmark tests was typical for its CPU class. Its Winstone 95 score was average. With its Micropolis hard disk and integrated controller, the system managed a slightly above-average Disk WinMark 95 score. The system's Genoa Phantom 64 graphics card with 2MB of DRAM helped it achieve a slightly below-average Graph-

ics WinMark 95 score.

Robotech offers a two-year parts and lifetime labor warranty; the first year of on-site service is free. If the company cannot identify and fix a problem, even upon in-house examination of the machine during the second year of warranty, it will replace the system.—AY

Robotech Inc., Midvale, UT; 800-533-0633, 801-565-0645; fax, 801-565-0680.

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Recommended Res:
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\$460 ESP
13" Flat Square Technology CRT
(13.8" viewable image size)
Max. Res: 1280 x 1024 NI at 60 Hz
Recommended Res:
1024 x 768 NI at 76 Hz**

MultiSync XV14™
\$330 ESP
14" Non-Clare CRT
(13.0" viewable image size)
Max. Res: 1024 x 768 NI at 70 Hz

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**AND FEEL THE
DIFFERENCE.**

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NEC

MultiSync XV7



\$799
ESTIMATED
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SUMMARY OF FEATURES

Pentium and Nx586 PCs

■ YES ■ NO

Products listed in review order

	TC-P5-75 Media	Tri-CAD P-75 Personal Workstation	Tri-CAD NTP100 Personal Workstation	Unisys SVI 51007	Unitak UT-P100	USA Flex PT-75 Desktop System	USA Flex PT-100 Tower System	ZDS Z-Station EX MDII
List price (tested configuration)	\$2,195	\$2,999	\$5,999	\$6,843	\$2,749	\$2,595	\$3,995	\$3,399
Processor	Pentium/75	Pentium/75	Pentium/100	Pentium/100	Pentium/100	Pentium/75	Pentium/100	Pentium/90
Installed RAM	16MB	16MB	16MB	16MB	16MB	16MB	16MB	16MB
Hard disk capacity and interface	515MB EIDE	1GB EIDE	973MB SCSI-2	1GB SCSI-2	1GB EIDE	813MB EIDE	1GB EIDE	515MB EIDE
Graphics adapter (and memory)	Diamond Stealth 64 (2MB)	ATI Graphics Xpression (2MB)	ATI Graphics Pro Turbo (4MB)	Matrox PCI MGA II (2MB)	ATI Graphics Xpression (4MB)	WD Paradise Bahamas 64 (2MB)	ATI Graphics Xpression (2MB)	Integrated ATI Mach64 (2MB)
Monitor (and diagonal screen size)	MAG DX15F (15")	IDEK Vision Master MF-8817 (17")	Viewsonic 21PS (21")	Unisys EVG500-COL (17")	Optquest 2000DC (15")	CTX 1562GM (15")	Orchestra Tube (17")	ZDS ZCM-1540 (15")
CD-ROM drive (and speed and interface)	TEAC CD-55A SuperQuad (4x proprietary)	Mitsumi CRMIC-FX400 (4x ATAPI)	Plextor 4Plex (4x SCSI-2)	Toshiba XM-3501B (4x SCSI-2)	Mitsumi CRMIC-FX400 (4x ATAPI)	Sony CDU-55E (2x ATAPI)	Mitsumi CRMIC-FX400 (4x ATAPI)	Mitsumi CRMIC-FX001DE (2x ATAPI)
Sound adapter	Creative Labs Sound Blaster 16 Value	Media Magic ISP-16	Orchid Sound Wave 32	Creative Labs Sound Blaster AWE32	Creative Labs Sound Blaster 16	Creative Labs Sound Blaster 16	Creative Labs Sound Blaster 16	None
Speakers/Network adapter/Modem included	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■
DOS, Windows version included	6.22, WinWg 3.11	6.22, WinWg 3.11	6.22, Win 3.11	6.22, WinWg 3.11	6.22, WinWg 3.11	6.22, Win 3.11	6.22, WinWg 3.11	6.22, WinWg 3.11
Motherboard Components								
Installed, maximum external RAM cache	256K, 512K	256K, 1MB	256K, 1MB	256K, 256K	256K, 256K	256K, 256K	256K, 256K	256K, 256K
Motherboard manufacturer	FIC	DFI	DFI	Intel	Intel	Intel	Intel	Intel
Chip set manufacturer and model	Intel Neptune	VLSI 82C591-3	VLSI 82C591-3	Intel Neptune	Intel Neptune	Intel Neptune	Intel Neptune	Intel Neptune
BIOS manufacturer and version (or date)	Award (11/24/95)	Award 4.50	Award 4.50G	AMI (7/22/94)	AMI (8/23/94)	AMI (8/23/94)	AMI (8/3/94)	AMI (12/9/94)
Flash BIOS/Plug and Play BIOS	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Multiprocessor socket	■	■	■	■	■	■	■	■
Expandability								
Maximum RAM	192MB	256MB	256MB	128MB	128MB	128MB	128MB	128MB
Expansion-bus slots	3 ISA, 4 PCI	3 ISA, 3 PCI, 1 PCI/ISA	3 ISA, 3 PCI, 1 PCI/ISA	4 ISA, 2 PCI, 1 PCI/ISA	4 ISA, 2 PCI, 1 PCI/ISA	4 ISA, 2 PCI, 1 PCI/ISA	4 ISA, 2 PCI, 1 PCI/ISA	2 ISA, 1 PCI, 1 PCI/ISA
Accessible drive bays (5.25", 3.5")	3, 2	3, 2	6, 1	3, 1	3, 1	3, 2	6, 0	2, 1
Internal drive bays (5.25", 3.5")	0, 2	0, 2	1, 1	0, 4	0, 1	0, 2	0, 4	0, 1
Power-supply wattage	200W	230W	230W	230W	230W	200W	250W	145W
Parallel, serial, mouse ports	1, 2, 0	1, 2, 1	1, 2, 1	1, 2, 1	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 1
EPP/ECP parallel interfaces supported	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Service and Support								
7-day, 24-hour live technical support	■	■	■	■	■	■	■	■
Standard warranty on parts/labor	2 years/Lifetime	2 years/Lifetime	2 years/Lifetime	3 years/3 years	1 year/1 year	3 years/Lifetime	3 years/Lifetime	3 years/3 years
On-site service charge (and term)	N/A	\$50 (1 year)	\$50 (1 year)	Included (3 years)	\$75 (1 year)	\$49 (1 year)	\$49 (1 year)	Included (1 year)

N/A—Not applicable. The product does not have this feature. BCM—BCM Advanced Research, FCT—Free Computer Technology, FIC—First International Computer.

Summit Micro Design Inc.

Mount Brooks
Mount McKinley

Summit Micro Design's \$3,640 Mount McKinley and \$2,995 Mount Brooks, both aimed at corporate power users, did fairly well on our benchmark tests. The Mount McKinley is powered by a 100-MHz Pentium CPU and Triton chip set, while the Mount Brooks uses a Pentium/75 and a Neptune chip set.

For the extra \$645, the Mount McKinley offers a 17-inch ADI monitor (versus the Mount Brooks's 15-inch model) and a quad-speed rather than a double-speed CD-ROM drive. Although the Mount McKinley uses Intel's Triton chip set, it was paired with pipelined-

burst SRAM but no EDO DRAM; the company says EDO DRAM will be available by the time you read this. Both units come with a Sound Blaster 16 audio card and external speakers.

The two units came in similar desktop cases that provide just enough room for growth. In the

IN SHORT

Summit's Pentium systems will please corporate power users.



Mount McKinley, memory upgrades are a bit troublesome since three of the four SIMM banks are underneath the power supply; all four SIMM banks were occupied in the configuration that we tested.

The two systems had mostly good scores on our tests. The Mount Brooks faltered on our Disk WinMark 95 tests, but otherwise garnered average results. The Mount McKinley produced average scores on our Disk WinMark tests, and above-average results on our Graphics WinMark 95 and Winstone 95 tests.

For an extra \$100 per system, the company will install hardware and software on-site anywhere in the U.S.—AY
Summit Micro Design Inc., Sunnyvale, CA; 408-739-6348; fax, 408-739-4643.

Circle 502 on reader service card

Ends

Zenon PCI Dream Media 4X	ZEOS Pantera Pentium-75	ZEOS Pantera Pentium-100
\$2,999	\$2,545	\$2,895
Pentium/100	Pentium/75	Pentium/100
16MB EDO	16MB	16MB
1 2GB EIDE	1GB Fast ATA	1GB Fast ATA
ATI WinTurbo (2MB)	Diamond Stealth 64 (2MB)	Diamond Stealth 64 (2MB)
MAG DX15F (15")	CTX 1562ES (15")	CTX 1562ES (15")
Mitsumi CRMC-FX400 (4x ATAPI)	Mitsumi CRMC-FX400 (4x ATAPI)	Mitsumi CRMC-FX400 (4x ATAPI)
Creative Labs Sound Blaster AWE32	Integrated ESS Audiocard ES1488F	Integrated ESS Audiocard ES1488F
■ ■ ■	■ ■ ■	■ ■ ■
6 22, W/Wg 3 11	6 22, W/Wg 3 11	6 22, W/Wg 3 11
256K, 256K	1256K, 512K	256K, 512K
Intel	PC Tech/ZEOS	PC Tech/ZEOS
Intel Triton	Intel Neptune	Intel Neptune
AMI (2/3/95)	Phoenix 4 04	Phoenix 4 04
■ ■ ■	■ ■ ■	■ ■ ■
128MB	1384MB	384MB
2 ISA, 3 PCI, 1 PCI/ISA	4 ISA, 2 PCI, 1 PCI/ISA	4 ISA, 2 PCI, 1 PCI/ISA
3.2	2.2	4.0
0.3	2.0	2.4
230W	200W	200W
1, 2, 0	1, 2, 0	1, 2, 0
■ ■ ■	■ ■ ■	■ ■ ■
1 year/1 year	1 year/1 year	1 year/1 year
Included (1 year)	\$59 (1 year)	\$59 (1 year)

Sys Technology Inc.

Sys Performance P100T

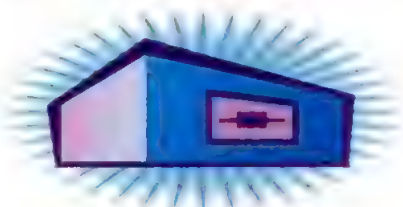
The Sys Performance P100T costs \$4,199, but for that price you get high-end performance plus a well-chosen group of components that includes a Nokia 17-inch monitor and a Toshiba quad-speed CD-ROM drive. Even though the P100T doesn't have the high-level integration features—such as on-board networking or sound—that come with some other systems in this price range, its tower case won't leave you wanting for room should you want to

IN SHORT

The P100T offers excellent performance, but it's somewhat expensive.

expand your system at some point in the future.

What sets this system apart is its performance on our benchmark tests. The Performance P100T lived up to its name with a first-place finish on the Disk WinMark 95 tests and a second-place Winstone 95 score. Its Graphics WinMark 95 result was also among the best in this



The Sys Performance P100T
lived up to its name, with a
second-place Winstone 95 score
among 100-MHz machines.

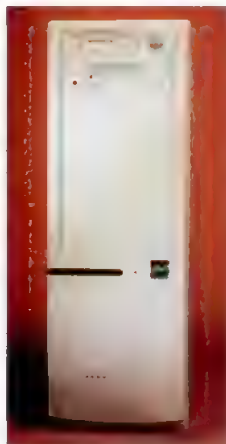
processor group, thanks in part to the ATI graphics accelerator card, which used the Mach64 chip set with 4MB of VRAM. The system also earned an average CPUmark₁₆ score. The machine is based on Intel's Triton chip set; although it did not use EDO DRAM or pipelined-burst cache, Sys says both will be available by the time you read this.

The Triton-based P100T has ten drive bays as well as plenty of available slots for PCI-based expansion cards or standard ISA cards. The interior of the case is clear of tangled wires and all the components are easily accessible.

Sys Technology offers a relatively standard one-year warranty on parts and labor.

Unfortunately, on-site service is an additional \$49 and is currently limited to Southern California, within a 30-mile radius of the company.—WPF
Sys Technology Inc., Cypress, CA; 714-821-3900; fax, 714-821-9592.

Circle 503 on reader service card



Tagram System Corp.

Thunderbolt P75 Thunderbolt P100

For \$2,195, the Thunderbolt P75 provides outstanding Windows performance. Its Pentium/100-based counterpart, the \$2,845 Thunderbolt P100, came through with average performance in its class, and it gives you more room for expansion than the P75. Tagram aims these systems at the home-office market and also sells its Platinum line of PCs through resellers.

The P75 was one of the best Pentium/75 performers in this roundup. It was the top-scoring system in its group on our Winstone 95 and Disk WinMark 95 tests. On our Graphics WinMark 95 tests, the unit placed in the top five. The P100 produced average results under Windows for its class, with one exception: its top-ten Disk WinMark score.

Both units came with 1MB of L2 cache (a \$75 upgrade). The effect on their CPUmark₁₆ scores was almost unnoticeable; both units—based on SIS chip sets—posted average results.

Despite its desktop case, the

IN SHORT

The P75 mates superb performance with a low price; the P100 is average.



P100 provides more expansion room than the mini-tower P75. In the P100, the floppy disk and quad-speed CD-ROM drives are integrated into one unit and use a single drive bay (a \$95 option for the P75). Four bays are left empty. The P75 is left with only two empty bays because it has separate floppy disk and double-speed CD-ROM drives. Also, you must remove a drive bay to access the P75's SIMM sockets; this is not a problem with the P100.

These systems are covered by a three-year parts-and-labor warranty.—WPF
Tagram System Corp., Tustin, CA; 800-824-7267, 714-258-3222; fax, 714-258-3220.
Circle 504 on reader service card

Tangent Computer Inc.

Tangent PCI-575 Tangent PCI-5100 Tangent NX5-P80 Tangent NX5-P100

Tangent Computer positions its Nx586-based Tangent NX5-P80 (\$2,250) and NX5-P100 (\$2,750) as less expensive alternatives to its PCI-575 (\$2,475) and PCI-5100 (\$2,995), which are based on 75- and 100-MHz Pentium CPUs, respectively. All four machines are targeted at the small-office/home-office markets.

The Pentium systems use a combination ISA/PCI architecture, while the Nx586-based units employ an ISA/VL-Bus architecture. Though each unit performed well across all benchmark tests, the NX5-P80 produced one notable result: an above-average score on our Winstone 95 tests. In a Winstone performance comparison of Tangent's NexGen-based PCs with its Pentium-based systems, we found an even price/performance trade-off between the NX5-P80 and PCI-575 units: a 10 percent price savings buys 10 percent less performance. The NX5-P100, however, offers 17 percent less performance than its Pentium counterpart, for only a 10 percent savings.

Though lacking software bundles, each system offers satisfactory multimedia components such as CD-ROM drives (the PCI-5100 has a quad-speed drive, while the others offer double-speed drives), and 16-bit sound cards capable of wavetable and FM synthesis. Diamond Stealth graphics cards with 2MB of VRAM and 15-inch monitors were also included with each unit.

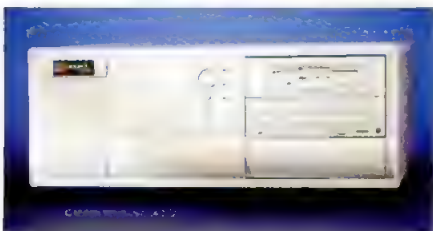
—Angela R. Hickman

Tangent Computer Inc., Burlingame, CA; 800-800-5550, 415-342-9388; fax, 415-342-9380.

Circle 505 on reader service card

IN SHORT

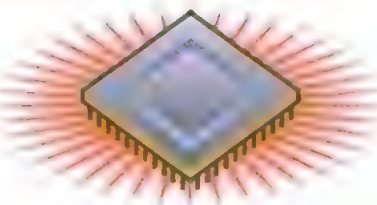
Tangent's Pentium machines are better buys than its Nx586 systems.



TC Computers Inc.

TC-P5-75 Media

TC Computers is clearly committed to Pentiums; to prove it, the company recently dropped its line of 486-based systems entirely. The company's newest offering, the 75-MHz Pentium-based \$2,195 TC-P5-75 Media mini-tower, is targeted at the small-office or advanced home-user market. Despite that positioning, it doesn't include any major CD-ROM titles such as Microsoft Encarta 95 or Microsoft Money. The TC-P5-75 Media was a mostly average performer on our benchmark tests.



The TC-P5-75 Media could not run Windows with 32-bit disk access enabled, which hurt its performance.

On the hardware side, the TC-P5-75 Media comes with a host of components for full multimedia support including a quad-speed TEAC CD-ROM drive, a Creative Labs Sound Blaster 16-bit sound card, a PCI-based Diamond Multimedia graphics card with 2MB of VRAM, and a MAG InnoVision 15-inch monitor.

In addition, this ISA/PCI system came with a Neptune chip set and a Western Digital IDE hard disk (515MB), whose Rocketbin drivers did not allow for optimal configuration. We were not able to run Windows when we enabled 32-bit disk access with the Rocketbin drivers,



IN SHORT

The TC system is an average performer at a very low price.

so we ran all of our Windows and DOS-based benchmark tests using the default Microsoft Windows 3.1 driver instead. Using this driver, the TC-P5-75 Media produced average results across the board excepting for its Disk WinMark 95 score, which was below average.

TC Computers provides a two-year warranty on parts and a lifetime warranty on labor.—ARH

TC Computers Inc., Jefferson, LA; 800-723-8282, 504-733-2527; fax, 504-733-3890.

Circle 506 on reader service card

Tri-Star Computer

Tri-CAD P-75 Personal Workstation Tri-CAD NTP100 Personal Workstation

Tri-Star Computer's high-end PC line consists of the \$2,999 Pentium/75-based Tri-CAD P-75 Personal Workstation and the \$5,999 Pentium/100-powered Tri-CAD NTP100 Personal Workstation. Both are designed for high-end CAD and other graphics applications. The NTP100 offers a lot for the money, such as a 21-inch monitor.

IN SHORT

Tri-Star's CAD-gear PC packs extras but lacks top performance.

Both units performed on a par with their respective competition, except on our Disk WinMark 95 tests.

Both systems offer all the features a power graphics user could want, including ATI Mach 64 graphics cards with 4MB and 2MB of VRAM in the NTP100 and P-75, respectively. The P-75 came with a 17-inch Idek monitor; the NTP100 used a 21-inch Viewsonic monitor, a \$1,100 upgrade from the 17-inch model. Both units also included quad-speed CD-ROM drives.

The NTP100 tower used a 1GB Fast/Wide SCSI-2 hard disk and a PCI disk controller. This setup did not help it on our Disk WinMark tests, the only tests on which it scored below average. It came with Microsoft Windows 3.11 installed and was unable to keep up with other units running Microsoft Windows for Workgroups.

The P-75 mini-tower came with a 1GB IDE hard disk connected to an integrated PCI disk controller. It also produced a

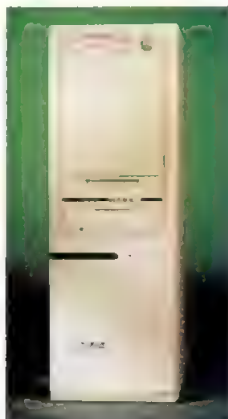


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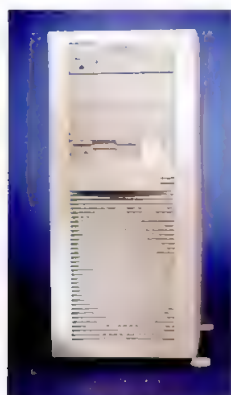
Circle 507 on reader service card

Unisys Corp.

Unisys SVI 51007

At \$6,843 list price (\$6,158 street price), the Unisys SVI 51007 was the most expensive PC in this entire roundup—nearly twice the price of most systems we tested. Neither its hardware nor its performance can justify the system's high price. Unisys markets the unit as a high-end desktop or entry-level server geared for corporation or government use.

The unit is built around a Neptune motherboard and uses an NCR PCI Fast SCSI-2 controller with an external SCSI-2 port. The SVI 51007's case



IN SHORT

Poor performance and a high price make this Unisys system one to avoid.

SERVICE & RELIABILITY

Reliability	Below average
Repair service	Average
Tech support	Below average

below-average Disk WinMark score, although its other test scores were average.

Each unit is backed by a two-year parts warranty that includes lifetime labor coverage.—*ARH*
Tri-Star Computer, Tempe, AZ;
800-473-6223,

in consistently below-average results. Since it couldn't exploit 32-bit disk access in Windows, its disk performance (and Disk WinMark 95 score) was poor, which contributed to a below-average Winstone 95 score. The system's Graphics WinMark 95 score was also slightly below average.

Unisys provides three years of on-site, next-day service worldwide and at an additional cost ships its systems with any commercially available operating system



The Unitek SVI 51007 is the most expensive PC in this roundup, but its hardware and performance were exceptional.

and business software.—*MDS*

Unisys Corp., San Jose, CA; 800-448-1424, 716-272-0880; fax, 716-272-6671.

Circle 508 on reader service card

Unitex Technology Inc.

Unitex UT-P100

The Unitek UT-P100 offers solidly average performance compared with other systems in the Pentium/100 CPU category. Though it lacks many of the amenities (such as 17-inch monitors and large software bundles) found with some of the units here, its performance and \$2,749 price tag make it easy to recommend.

This system includes some good components, such as a Graphics Xpression card with 4MB of VRAM, a 1GB Western Digital hard disk, a Sound Blaster 16-bit sound card capable of FM synthesis, a Mitsumi quad-speed CD-ROM drive, and an Optique 15-inch monitor. All drive controllers are integrated on the ISA/PCI-based motherboard; the motherboard is powered by Intel's Neptune chip set. Newer Triton-based systems, available by the time you read this,



IN SHORT

The Unitek machine is a solidly average general-purpose system with no frills.

shipped too late to be included here.

The desktop case has four accessible drive bays and one internal bay. Two of the accessible bays are free; the internal drive bay holds the hard disk.

The UT-P100 proved to be a good performer on our Windows-based benchmark tests. The system's results on our Winstone 95 and Disk WinMark 95 tests were average for its CPU group, as was its Graphics WinMark 95 score.

Unitex offers a standard warranty with on-site service available for \$75.—*WPF*
Unitex Technology Inc., Ontario, CA; 800-944-9700, 909-930-5700; fax, 909-930-5710.

Circle 509 on reader service card

USA Flex Inc.

PT-75 Desktop System PT-100 Tower System

USA Flex is a mail-order vendor serving both home and business PC users. Its two representatives in this roundup, the \$3,995 PT-100 Tower System, based on a 100-MHz Pentium processor, and the \$2,595 PT-75 Desktop System, employing a 75-MHz Pentium processor, came with a trove of multimedia software and some hardware amenities, too. Both systems were generally average performers on our benchmark tests.

Both machines built their multimedia systems around Sound Blaster 16 sound cards (the PT-100's card has FM and wavetable synthesis capabilities; the PT-75 is capable of FM synthesis only). The PT-100 adds a Turtle Beach RIO MIDI synthesizer module, as well as Altec Lansing ACS31 speakers and a large subwoofer. It also includes a 17-inch Orchestra MultiSystems monitor in place of the 15-inch monitor used with the PT-75.

Both machines posted average scores across our Windows-based tests, with one exception: The PT-100 managed only a below-average Graphics WinMark 95 score. It used an ATI Graphics Pro Turbo 64-bit graphics card with 2MB of memory; its performance was simply surpassed

11; 800-872-3539, 708-351-9700; fax, 708-351-7204.

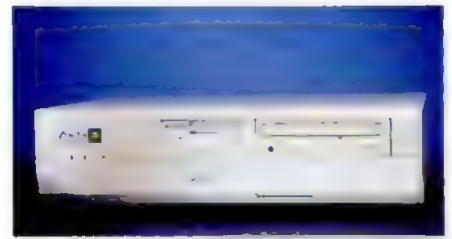
Circle 510 on reader service card

Zenith Data Systems

ZDS Z-Station EX MDII

Zenith Data Systems' \$3,399 (\$2,950 street price) ZDS Z-Station EX MDII is a winner, packing top-performing technology into a slimline case at a good price. The Pentium/90-based PC is an updated version of an Editors' Choice from our issue of December 6, 1994, updated with a larger hard disk and faster CD-ROM drive.

ZDS's systems are aimed squarely at corporate users, so it's no surprise that the Z-Station came with a SMC Ethernet network interface card (NIC) installed. The Z-Station has integrated graphics, disk, and I/O controllers, but the NIC and the other two cards in the system—a Sound Blaster 16 and a 14.4-Kbps modem—occupy all but one PCI slot on the slimline unit's riser card. The unit also has only a single drive bay



available.

One of our favorite touches: The unit includes a handy map of motherboard components pasted to the drive bay cage inside the case, which simplifies maintenance.

The Z-Station posted mostly average scores. It had the best Winstone 95 score of the handful of 90-MHz units; its score within the average range even for Pentium/100 PCs. Though we've often been disappointed by integrated graphics systems with weak components, this unit uses a top-notch 64-bit ATI Mach64 chip

IN SHORT

The Z-Station is an admirable slimline PC with quality documentation and support.

SERVICE & RELIABILITY

Reliability	Below average
Repair service	Below average
Tech support	Below average



IN SHORT

USA Flex's machines are average performers filled with multimedia extras.

by other machines that used Diamond Stealth cards or Intel's Triton core-logic chip sets.

The two Flex units come with Microsoft Works and Microsoft Money, in addition to assorted CD-ROM titles such as Grolier's Multimedia Encyclopedia and King's Quest IV. —RSA

USA Flex Inc.,
Bloomington,

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Add-on Printer Module	PSN3	\$9

Pentium and Nx586 PCs

set with 2MB of VRAM, which helped it match its competition on our Graphics WinMark 95 tests.—*RSA*

Zenith Data Systems, Buffalo Grove, IL; 800-533-0331, 708-808-5000; fax, 800-472-7211.

Circle 511 on reader service card

Zenon Technology Inc.

PCI Dream Media 4X

At \$2,999, Zenon's PCI Dream Media 4X is one of the lowest-priced Pentium/100s in this roundup. The system is intended for those users involved in CAD or desktop publishing and its performance on our Windows-based tests was very strong.

The Dream Media came in a mini-tower case with five free drive bays. There were two ISA and three PCI slots free. A 1.2GB hard disk was included, as was a Mitsumi quad-speed CD-ROM drive and an ATI WinTurbo graphics card with 2MB of DRAM. Additional features for the multimedia-oriented include a Creative Labs Sound



IN SHORT

Zenon's system comes with all sorts of goodies for a very low price.

a strong performer on our benchmark tests. The system turned in above-average Winstone 95 and Disk WinMark 95 scores compared with its Pentium/100-based competition. The Dream Media's Graphics WinMark 95 score was average for its CPU class.

Zenon offers a one-year parts-and-labor

Blaster 16 sound card, which can support both FM and wavetable synthesis; two external speakers; and software such as Microsoft Encarta 95, Microsoft Money, and Microsoft Works, among others.

The Dream Media, based on the Triton chip set and supported by 16MB of EDODRAM, was

warranty with one year of on-site service included. An additional three-year warranty is available through GE for \$199.—*MEB*

Circle 512 on reader service card

ZEOS International Ltd.

Pantera Pentium-75 Pantera Pentium-100

ZEOS's \$2,545 Pantera Pentium-75 and \$2,895 Pantera Pentium-100 are great values. Not only do they perform well and offer a well-integrated design, they are among the lowest-priced Pentium-based systems in this roundup. ZEOS also sells Ambra PCs, a low-cost workstation line not reviewed here (and unrelated to IBM Corp.'s now-

IN SHORT

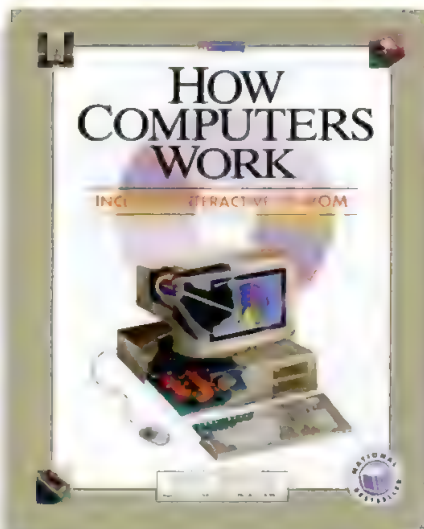
Respectable performance and aggressive prices make the Panteras great values.

SERVICE & RELIABILITY

Reliability	Above average
Repair service	Above average
Tech support	Above average

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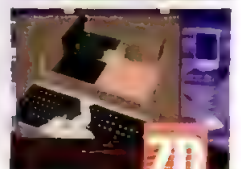
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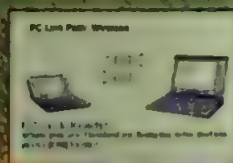
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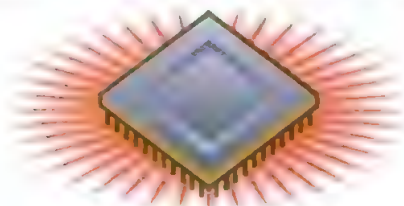
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defunct Ambra series).

Except for the case style, the two Pantera systems were identically configured. Hard disk and CD-ROM drive controllers, as well as a 16-bit sound chips, are integrated on the ISA/PCI motherboards. A socket on the motherboard accommodates an optional SCSI chip (\$49), Ethernet interface (\$119), or combination chip (\$159); these are factory-installed options. ZEOS also sent quad-speed CD-ROM drives (and Lotus SmartSuite on CD-ROM) and 1GB hard disks with each system.

The Diamond Stealth 64 graphics card made the Panteras' performance on our



The ZEOS Panteras combine great performance with some of the lowest prices for Pentium systems in this roundup.

Graphics WinMark 95 tests stand out. The card used the just-released S3 Vision 968 graphics chip instead of the more common Vision 964, resulting in above-average Graphics WinMark scores for the Pentium-75 and Pentium-100. The two Panteras had average scores on the rest of our tests.

ZEOS provides 24-hour, 7-day telephone support. The company offers a one-year parts-and-labor warranty, which is upgradable to three years for \$99. On-site service is \$59 for one year.—JLW □
ZEOS International Ltd., Minneapolis, MN; 800-554-7172, 612-362-1234; fax, 612-362-1205.

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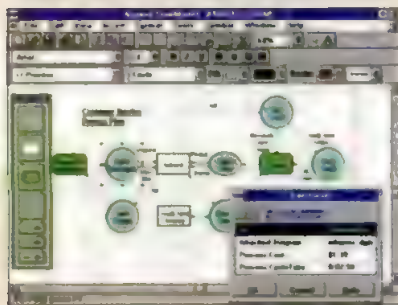


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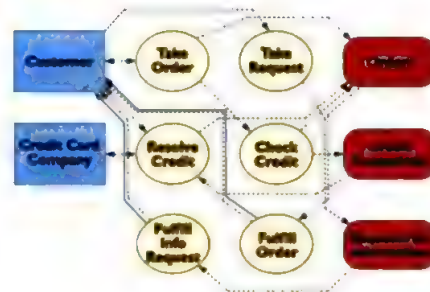


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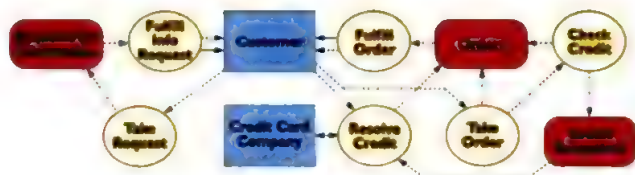
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IMITATES CHART



Like the storyboards filmmakers use, flowcharts serve as points of reference for scenarios that can change at any time. But in reality, flowcharts are far more complex to organize and maintain than storyboards.

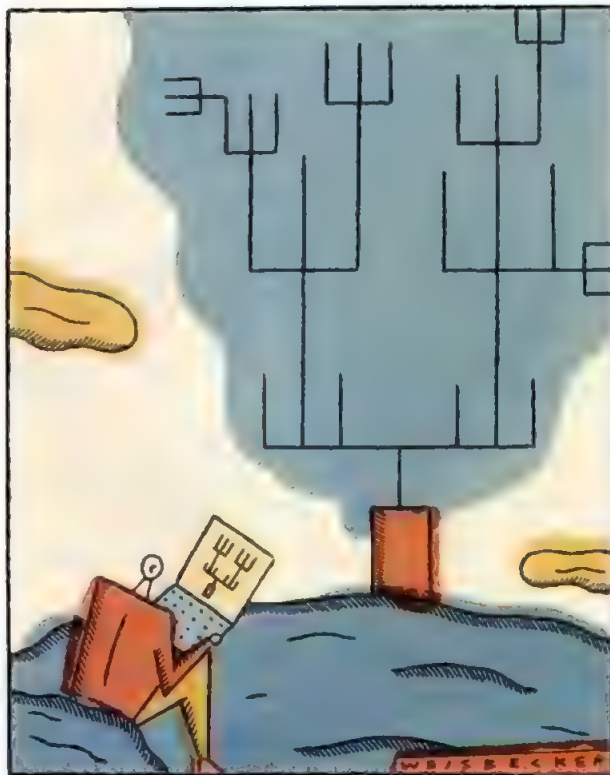
Flowcharting packages let you build diagrams of processes and organizational hierarchies and other business and technical diagrams that you can't create easily in any other kind of software. We survey flowcharting packages that you can use for business planning, quality control, and a variety of other diagramming purposes such as organization charts, network diagrams, space planning, and even mapping.

Our last evaluation of diagramming software (*Designing Your Thoughts*, December 21, 1993) was divided into two sets of re-

By Edward Mendelson

► IN THIS REVIEW

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views, one for multipurpose diagramming tools and one for flowcharting and organization-charting tools. Our current evaluation incorporates flowcharting tools that support organization charts and schematic diagrams. This amalgamation reflects a blending of the two previously separate but parallel worlds of diagramming and flowcharting or organization charting. Slight distinctions remain: For instance, Shapeware's Visio offers many different diagramming stencils, and Micrografx's ABC FlowCharter has business-related data-analysis features.

All nine packages in our current evaluation run under Microsoft Windows, and almost all use a similar interface that consists of a drawing window, a palette of standard or customized shapes for use in a chart, and a set of toolbars for controlling shape, text, and line attributes. Clear Software's allClear III differs in that you can use a script language to create a chart instead of creating it in a drawing window.

Another common feature is the ability to create complex, multipage flowcharts using a variety of palettes. Some packages add general-purpose symbol palettes; Visio's map symbols and CorelFLOW's cornucopia of clip art come to mind. ABC FlowCharter now lets you create data-analysis charts like those drawn by spreadsheets and statistics packages. The package also includes ABC SnapGraphics, which lets you create charts that you

• ABC FlowCharter • allClear

With tools for working out decisions and processes and for depicting scenarios, the best flowcharting products let you apply both logical and creative thinking to the charts you create.

Our two Editors' Choice winners, Micrografx's ABC FlowCharter 4.0 and Clear Software's allClear III for Windows, take full advantage of the Windows environment by offering easy-to-use tools for assembling attractive and informative charts.

ABC FlowCharter has a great number of symbols, supports OLE 2.0, and offers such intelligent features as a collision-avoidance algorithm to help ease the charting process. You'll also find recently improved integration capabilities and a better implementation of the graphical interface. The package includes three modules in addi-

tion to the main program: ABC SnapGraphics, DataAnalyzer, and Viewer.

allClear III lets you develop your charts in script format before you view the chart in diagram form. The package is tailor-made for users who would rather focus on the logic and the process in a chart than on the graphical manipulation of symbols and connectors.

You enter a script in the supplied editor or import your own script, viewing the chart as you go along. It takes about an hour to learn the simple, plain-English scripting language, which is more like an enhanced outlining system than a pro-

normally expect to build by hand such as pyramid and spoke-and-center diagrams.

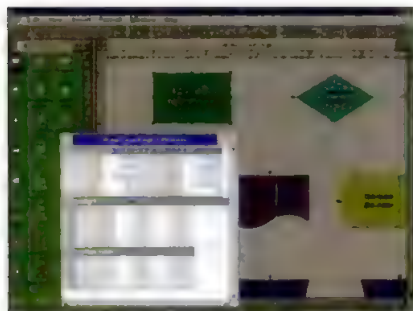
Packages designed to produce only organization charts are not covered in this survey, but one deserves special mention. Banner Blue Software's Org Plus for Windows (510-794-6850), with

an estimated street price of \$140, can automatically move subordinates when you move managers. You can use the built-in spreadsheet to calculate, for example, average salaries and other totals. The program can build from a simple text file an organization chart in which

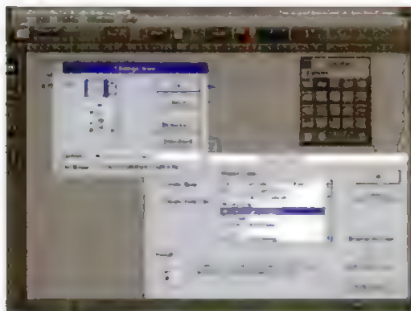


HIGHLIGHTS

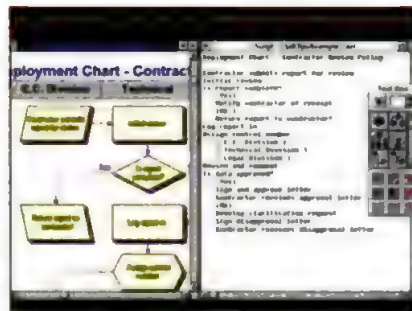
The Right Features for the Right Job



GRAPHICAL INTERFACE FEATURES such as snap-to-grid options, Windows' MDI (Multiple Document Interface) support, and advanced manipulation of shapes, lines, and text ease the flowcharting process. This is Visio's SmartSheet, in which you define shapes and their behavior.



INTEGRATION is key if you regularly swap data between your flowcharting package and your other applications. OLE 2.0 automation, in several of the reviewed packages, lets you work easily with other OLE-compliant applications. This example shows some of ABC FlowCharter's OLE options.



GO BY THE SCRIPT if it's easier for you to spell out links than it is to draw them. With Clear Software's allClear, you can write your flowchart in a script before you see the actual flowchart. The scripting language lets you perfect the nuances of your work.

Flowcharting Software

gramming language. You can manipulate charts graphically once they've been scripted and use any of the 108 sample scripts and 32 templates to ease the scripting and charting process. Other features that round out the package include OLE 1.0 server and Lotus Notes/FX support and the ability to link diagrams together and attach nodes to any file. Sophisticated printing features include intelligent page breaks.

We give special mention to Shapeware's Visio, an exceptional general-purpose diagramming package. Its wide variety of technical charts, maps, architectural layouts, and other kinds of charts make it perfect for people who need lots of schematics and templates. You can also buy specialized add-on shape packages from Shapeware. Among the myriad graphical niceties is the ability to manipulate text, shapes, and lines extensively. Built-in toolbars and OLE 2.0 provide tight integration with Lotus 1-2-3, Microsoft Excel, and Microsoft Word for Windows.

each line identifies an employee by name, title, and his manager's name. Microsoft PowerPoint 4.0's organization-chart module is, in fact, an OEM version of Org Plus.

For those looking for more than organization-charting tools, what follows should serve as both a guide and a reference point—much like a well-designed flowchart—for helping you select the product that's right for you.

Micrografx Inc.

ABC FlowCharter

BY EDWARD MENDELSON



Micrografx's \$495 ABC FlowCharter 4.0 combines a dazzling level of automation with a profound depth of features. It doesn't have the prettiest interface, and it lacks graphic-design features such as layers and rotated shapes, but it can produce a variety of professionally polished business charts in record time.

The package specializes in simplifying repetitive tasks. You can connect

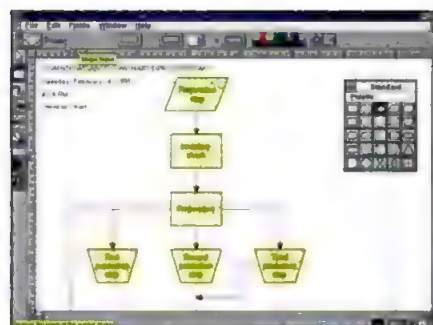
two shapes simply by dragging the second shape from a palette, clicking on the first shape, and then dragging the second shape into position. If you remove one shape from between two others, the connecting lines instantly rejoin to preserve the continuity of the chart (a feature you can't turn off). If one connector line crosses another, a semicircular bump automatically appears in one of the lines to indicate a crossover. Otherwise, you can choose from an options menu to have a small break appear instead, or leave the crossover as ordinary intersecting lines.

ABC FlowCharter is a marvel of automation. You can number and renumber shapes, and in organization charts all segments of a horizontal line move together when you move one segment. You can also link shapes to other charts or to applications. The package displays and exports an outline-style index of shapes in all open charts. When you double-click on a shape's name in the index, the shape appears on-screen and becomes the selection. Data fields attached to shapes let a chart perform basic spreadsheet functions. OLE automation lets you modify the behavior of shapes and charts so that, for example, any shape that is moved changes to a specific color.

DRAWN TO FLOW CHARTS

The package ships with 29 palettes containing shapes for use in quality control, auditing, deployment, network, flow, organization, and other standard business charts but not for advanced technical charts such as circuit diagrams. Each shape is explained in bubble help and on the status line,

and a mouse-click brings up a window in which you can change a shape's design and behavior. You can customize palettes with bitmap or vector images imported via the Clipboard, but file import is limited to .WMF format and charts from HavenTree Software's EasyFlow. The program can make a chart fit a printed page, but you have no specific scaling options.



ABC FlowCharter's relatively sparse interface includes bubble help and descriptive names of shapes.

The full package contains four separate modules. First is ABC FlowCharter itself, which you use for all standard business charts, including fish-bone, organization, and flowcharts. The second, ABC SnapGraphics, is a less advanced tool for more casual users, but it can create circle-and-spoke, pyramid, and other charts that you can't create easily in ABC FlowCharter. ABC DataAnalyzer creates histograms and other statistical-analysis charts using data typically imported from spreadsheet files. A runtime-chart viewer, the fourth module, may be distributed freely.

These modules have different interfaces, and although you can save a SnapGraphics chart in FlowCharter format, you lose graphic subtleties such as shading. A couple of times we received a GPF when saving a SnapGraphics chart in FlowCharter format, even though the chart itself was saved correctly.

ABC FlowCharter is a gigantic program with unique powers. It isn't cheap, and it doesn't

have the graphic prowess of Visio, but the range, depth, and automation of its business charting make it well-suited for corporate use.

ABC FlowCharter 4.0. Estimated retail price: \$299.95. Requirements: Microsoft Windows 3.1, 4MB RAM, hard disk space: 5MB minimum, 21MB maximum. Micrografx Inc., 1303 Arapaho Rd., Richardson,

SUITABILITY TO TASK		
ABC FlowCharter		
Chart manipulation	Excellent	Excellent
Integration/Programmability	Excellent	Excellent
Output	Excellent	Excellent

Our Contributors: EDWARD MENDELSON and CRAIG STINSON are contributing editors to *PC Magazine*. KATHLEEN CASTER, staff editor, and LANCE ULANOFF, associate editor, were in charge of this story.

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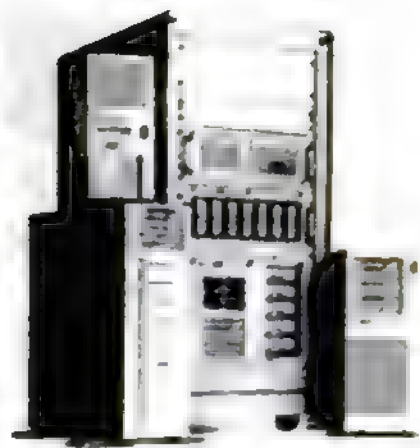
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Fig. 1 Backbone

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Clear Software Inc.

allClear for Windows

BY CRAIG STINSON



Unlike all other programs in this evaluation, Clear Software's allClear III for Windows is not a drawing package. Instead, the \$299 allClear generates process, decision tree, organization, and fish-bone diagrams from scripts written in a simple scripting language. You can use drawing tools and add bitmaps to adjust and add to a diagram, but the diagram's structure is controlled by its script.

Does this approach makes sense? It does if you'd rather put your energy into defining structure than into depicting it. Moreover, the program assists so well with script generation and offers so many well-designed alternatives regarding the final appearance of its diagrams, that many users will be relieved not to have to rely on drawing tools.

You enter scripts in a supplied editor; you can also import them from your own editor. You can split the screen to show both diagram and script, or toggle be-

tween screens. A click in the diagram window updates the diagram to the current state of the script. In the script, you type the text that will appear in each diagram shape and use punctuation to indicate connections between shapes. A period denotes a sequential step, for example, while a question mark introduces a yes/no branch. Acquiring a working knowledge of the language will take only about an hour.

You can diagram first and study later, thanks to 108 sample scripts for numerous common diagram archetypes. The ability to diagram first is new to this version and makes the package more accessible than previous versions. Templates (there are 32) include fill-in-the-blank placeholders containing instructions such as "<Statement on Yes Branch>". When you put

SUITABILITY TO TASK

allClear

	Power	Ease of use
Chart manipulation	Excellent	Good
Integration/Programmability	Excellent	Excellent
Output	Excellent	Excellent

your cursor anywhere on the placeholder line and type, the template instruction is replaced by your text.

STYLISTIC MEASURES

In the diagram window, you can apply stylistic changes either globally or locally.

SUITABILITY TO TASK

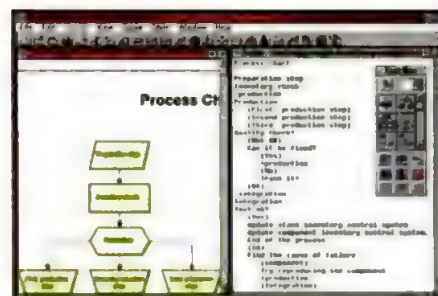
Company Name

	Power	Ease of use
Chart manipulation	Excellent	Excellent
Integration/Programmability	Good	Good
Output	Fair	Fair

attach fields to shapes and import field data from spreadsheets and databases

In our **Output** task, we rate the packages' printing and exporting features. The print features we evaluate include the ability to let users scale a chart to arbitrary levels and force a chart to fit a page. We also look for a print-preview or show-page feature. In evaluating export features, we rate packages well if they let you export files to .WMF, .BMP, and other standard formats.

In our **Integration/Programmability** task, we look for OLE 2.0 client and server support, hierarchical diagrams, and the ability to set up charts so that a user can click on a shape to launch another application



Once you learn allClear's script language, shown here on the right, the package generates attractively formatted diagrams automatically.

Style choices are recorded in a separate file that can be merged with any script file to achieve consistency across diagrams. To facilitate global changes, the program offers a button that you click to cycle through canned formatting combinations appropriate for the current diagram. Other packages achieve the same effect by saving customized templates or offering similar features. To help you make local changes, a right mouse-click brings up a one-stop property dialog. You can also drag handles to change a symbol's size or shape (but not its position), or click on a draw palette to add boxes, straight lines, or text. For further adornment, allClear supplies 50 clip-art images.

allClear lets you link diagrams and attach a node to any file. You can store the linked diagrams in one file, rather than go through the arduous process of linking files on your disk. The package also lets you distribute a runtime version of flowcharts.

Printing features include scaling to a single page, intelligent page breaks, the option to omit blank pages, and page mapping. If you map, a footer indicates the numbers of continuing pages on the top, bottom, left, and right.

The program has OLE 1.0 server and 5 Lotus Notes/FX support, exports .WMF files, and can generate diagrams from data stored in .WK1 and .DBF files. With just a bit of preprocessing, you can make your .DBF file a data source for an organization chart, so that diagram boxes automatically pick up personnel data in .DBF fields.

allClear III's modus operandi may not be suitable for all users, but it's a remarkably effective way to generate a wide range of stylish diagrams.

allClear III for Windows. List price: \$299.

Suitability to Task: Flowcharting Software

The art of creating a flowchart can be pretty straightforward. But when you're trying to develop a coherent chart, you might find a messy, non-sensical array of lines and shapes on your hands if the package you're using doesn't offer plenty of automation and customization features.

We rate each product for *Power* and *Ease*. *Power* refers to the wealth and strength of features, and *Ease* addresses implementation. Usability is figured into each product's *Ease* rating.

In our **Chart Manipulation** task, we evaluate packages' chart types, creation tools, and variety of templates. We also evaluate the ability to insert a line automatically between two shapes and respond intelligently when the user breaks a connection. Also in this task we rate the packages' abilities to

Does the perfect office really exist?



Flowcharting Software

Requirements: Microsoft Windows 3.1, 4MB RAM, 6MB hard disk space. Clear Software Inc., 199 Wells Ave., Newton, MA 02159; 800-338-1759, 617-965-6755; fax, 617-965-5310; BBS, 617-965-5406; CIS, 72662, 2561

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Corel Corp.

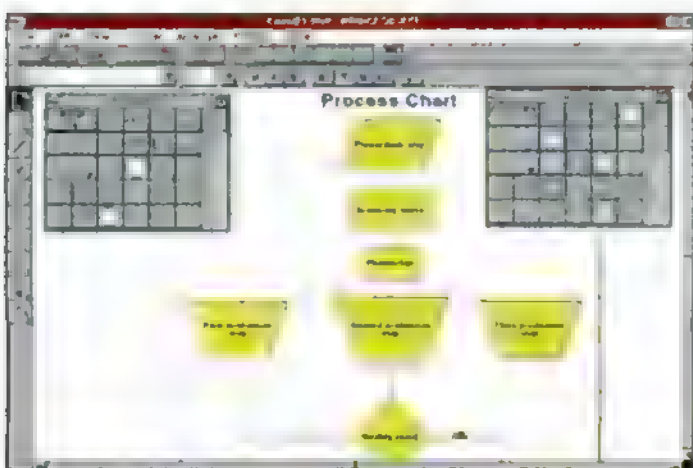
CorelFLOW

BY CRAIG STINSON

Corel Corp.'s \$99 CorelFLOW 2.0 offers a sophisticated marriage of drawing tools and symbol libraries. The CD-ROM version has over 1,000 clip-art images, 100 fonts, and over 1,000 photos. On floppy disks, the goody count is lower but still substantial. You can import the images and use them as symbols in your flowcharts.

SUITABILITY TO TASK		
CorelFLOW		
	Power	Ease of use
Chart manipulation	Excellent	Excellent
Integration/Programmability	Good	Excellent
Output	Fair	Good

CorelFLOW's drawing tools provide full control over the positioning, alignment, formatting, rotation, and opacity of lines, curves, ellipses, rectangles, and text objects. The 90 symbol libraries (on either CD-ROM or floppy disk) include more than 2,000 objects encompassing everything from standard ANSI flowchart symbols to items for architecture, auditing, wiring, landscaping, mapping, and computer networking. The symbol sets also include a variety of purely decorative objects such as borders, human faces and figures, and portraits of celebrities.



CorelFLOW comes with a wealth of symbols and art, presented in the form of 90 roll-up library windows.

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Symbols on a CorelFLOW diagram can invoke subordinate diagrams or launch other Windows applications. The tutorial supplied with the program is itself an example of the kind of hierarchical structure that CorelFLOW can build. CorelFLOW also supports OLE 2.0 as both server and client.

CorelFLOW allows a finer degree of graphical control than most other flowcharters. For example, you can attach lines to nonstandard connection points as easily as to corners and midpoints. Connectors can be straight or curved and can have as many elbows as the geometry of your diagram requires. Unfortunately, this degree of tunability means you have to work a little harder when a diagram is rearranged. CorelFLOW will adjust the last leg of your connectors, but you have to rearrange the elbows.

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ing is available, but the automatic scale-to-single-page feature proved buggy in our tests. Other desirable features not present include page templates and support for Windows' Multiple Document Interface (MDI).

Deficiencies aside, CorelFLOW provides a whole lot of diagramming functionality. If you want a wide range of symbols at an impulse-level price, this is the package for you.

CorelFLOW 2.0. List price: \$99. Requirements: Microsoft Windows 3.1 or higher, 4MB RAM (6MB recommended), 5MB hard disk space. Corel Corp., 1600 Carling Ave., Ottawa, Ontario, Canada K1Z 8R7; 800-772-6735, 613-728-8200; fax, 613-761-9176; CIS, Go Corel.

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HavenTree Software Ltd.

EasyFlow for Windows

BY CRAIG STINSON

HavenTree Software's EasyFlow 1.0 for Windows is a few-frills flowcharting program that has two important things going for it: It handles connecting lines in an unusually smart fashion, and it includes several valuable and uncommon printing options. The package is regularly \$299 and will list for \$199 until the end of May this year.

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SUITABILITY TO TASK		
EasyFlow		
	Power	Ease of use
Chart manipulation	Good	Good
Integration/Programmability	Poor	Fair
Output	Excellent	Good

is mostly successful. EasyFlow's interface is uncomplicated and supports Windows' MDI. The program employs floating-symbol palettes, a small top-docked toolbar, and five other floating toolboxes. Two of these are for selecting connector styles for the beginnings and endings of lines; the rest are for formatting shapes, lines, and text:

The lines that flow on an EasyFlow chart must be rectilinear. (Version 2.0., which was due in March 1995, will sup-

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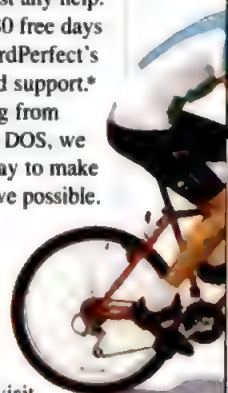
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Corel Corp.

CorelFLOW

BY CRAIG STINSON

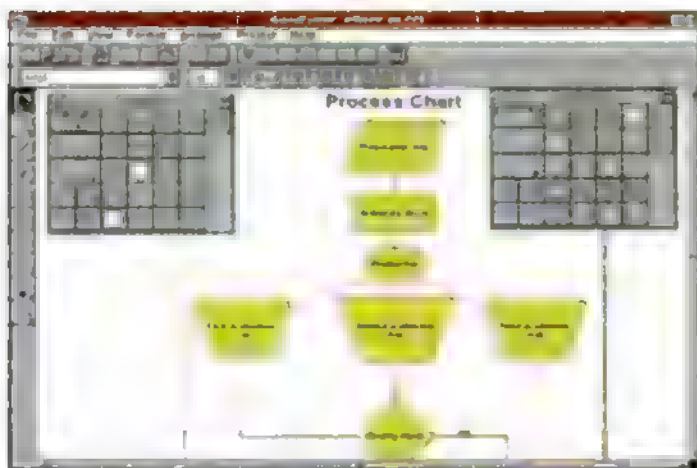
Corel Corp.'s \$99 CorelFLOW 2.0 offers a sophisticated marriage of drawing tools and symbol libraries. The CD-ROM version has over 1,000 clip-art images, 100 fonts, and over 1,000 photos. On floppy disks, the goody count is lower but still substantial. You can import the images and use them as symbols in your flowcharts.

SUITABILITY TO TASK

CorelFLOW

	Power	Ease of use
Chart manipulation	Excellent	Excellent
Integration/Programmability	Good	Excellent
Output	Fair	Good

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SUITABILITY TO TASK

EasyFlow

	Power	Ease of use
Chart manipulation	Good	Good
Integration/Programmability	Poor	Fair
Output	Excellent	Good

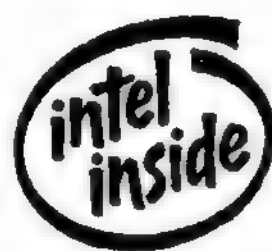
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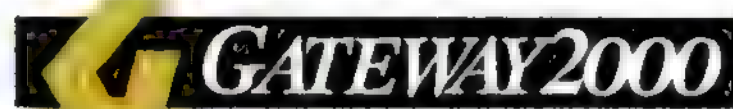


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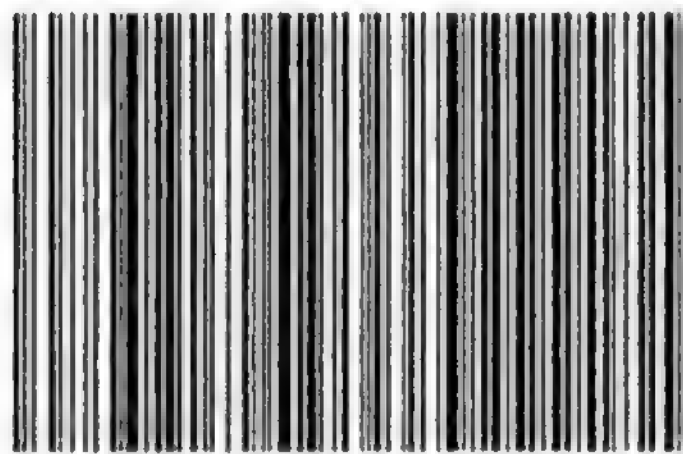


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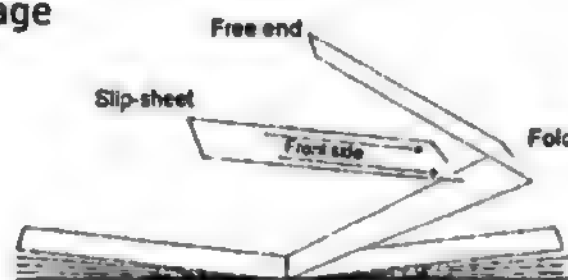


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3. Slice the folded edge
4. Close the page and slip-sheet



1. Open the foldout page

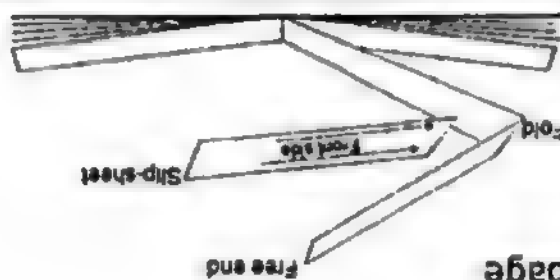
2. Insert this sheet with

1. Front side touching the free page

2. Arrow pointing to the fold

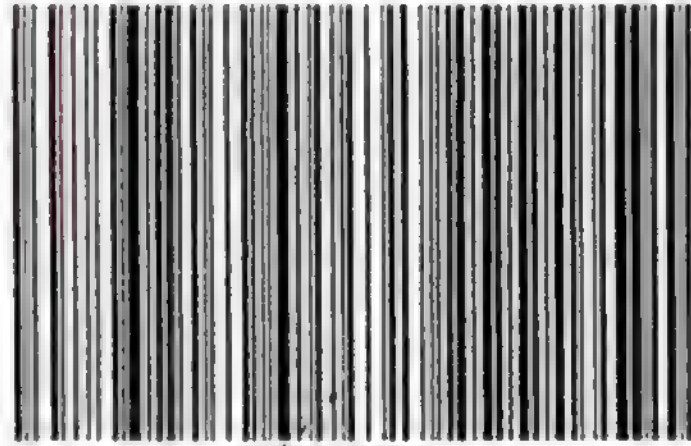
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1. Follow instructions on the other side



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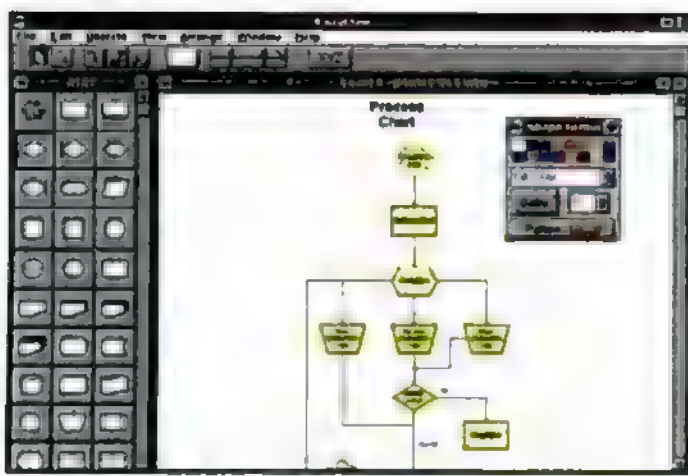
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Flowcharting Software



EasyFlow's three "gizmos" let you customize shapes, connectors, and text.

port diagonal curved lines and will have a connector palette.) EasyFlow automatically arranges its lines so that they don't cut through intervening shapes or across text or other lines. A manual line mode always follows user-defined paths. If you plop a new shape down on your diagram, the existing lines automatically hop out of the way. To accommodate exceptionally complex diagrams, you can fine-tune the collision-avoidance algorithm, using a scale from "cross easily" to "don't cross."

EasyFlow supplies 15 shape libraries. Populating a diagram is a matter of dragging symbols to the drawing window. There's considerable duplication among the palettes, so the total breadth of the library is small compared with other programs.

FINE PRINT

EasyFlow lets you print to a single page, define scaling factors, and select page-overlapping and page-mapping options. Other print options include off-page connectors, horizontal and vertical centering, and page breaks that automatically avoid bisecting your symbols. With page overlapping, the program repeats a small section of your diagram at the end of one page and the start of another, making it easier for you to tape the output together. Page mapping adds a legend to the upper-left and lower-right corners of each page. The legend indicates which page numbers provide the diagram's continuation. With off-page connectors, you can figure out which line on a succeeding page continues a line on the current page by matching up numbers appearing along page boundaries.

If simplicity is crucial, EasyFlow is

worth a look. But the tradeoff for ease here is a relative lack of versatility.

EasyFlow 1.0 for Windows. List price: \$299. Requirements: Microsoft Windows 3.1 or later, 4MB RAM, 3.5MB hard disk space. HavenTree Software Ltd., P.O. Box 470, Fineview, NY 13640; 613-544-6035; fax (information service), 613-544-2049; fax (general), 613-544-9632; CIS, 76366, 512.

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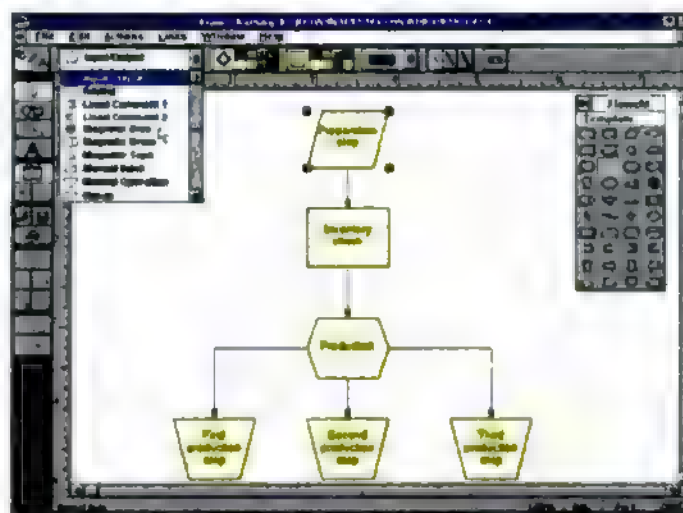
Patton & Patton Software Corp.

Flow Charting 4 for Windows

BY EDWARD MENDELSON

Patton & Patton's \$199 Flow Charting 4 for Windows, Version 1.03, is a single-purpose package that lets you draw standard flowcharts and organization charts easily—and tries to be an illustration package at the same time. It doesn't offer much automation, and its interface has some clumsy patches. But the package focuses on providing conveniences: One feature lets you repeat the previous action by clicking the right mouse button, and another (the Snapshot feature) sets the default-line weight, color, and other attributes when you modify a shape and simply click on a button.

The package has 12 standard shape templates, including three designed for quality-control charts, and an overly complex menu lets you create custom templates by mixing shapes from the supplied templates. You can't add a custom shape to a template, although you can import a custom shape via the Clipboard and save it in a chart file for import into other charts.



Flow Charting 4 uses a drop-down list of template objects in addition to the template itself.

As in most flowchart programs, the screen consists of a set of standard toolbars, a drawing area, and a shape template. An automatic redraw feature, activated by the Hammer button, is designed to find the most efficient path for lines after you move shapes, but you often have to make manual readjustments anyway.

BASIC CHART BUILDING

Only one template at a time appears on-screen, although you can have more than one chart visible or iconized. Some aspects of the interface may be unsettling to users. Instead of creating a connector by dragging with the mouse, you click and release on the starting point, move the mouse to draw the line, and then click again to complete the line. You build branched lines by drawing a connector from a shape to an existing line.

Menu options let you create links between a shape in one chart and a page in another. If you simply want to link two pages in the same chart, you have to select the current chart by name in a dialog box, and

SUITABILITY TO TASK

Flow Charting 4

	Power	Ease of use
Chart manipulation	Fair	Good
Integration/Programmability	Fair	Good
Output	Fair	Fair

then specify the page number of the target instead of simply pointing and clicking.

Flow Charting 4 lacks a print-preview feature, and it doesn't let you rotate text. It can only rescale to fit a page by resizing to 80 or 125 percent, which you can do repeatedly.

In our last flowcharting evaluation, Flow Charting 3 was a slightly clumsy DOS-based package; the package has made progress since then. Flow Charting 4 provides simple, classic flowcharting without extras. Version 2.0, due in April 1995, will have additional templates, a spell-checker, and improved import and export support.

Flow Charting 4 for Windows. List price: \$199. Requirements: Microsoft Windows 3.1, 4MB RAM, 3MB hard disk space. Patton & Patton Software Corp., 485 Cochrane Circle, Morgan Hill, CA 95037. 800-525-0082, 408-778-6557; fax, 408-778-9972; BBS, 408-778-9697.

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Flowcharting Software

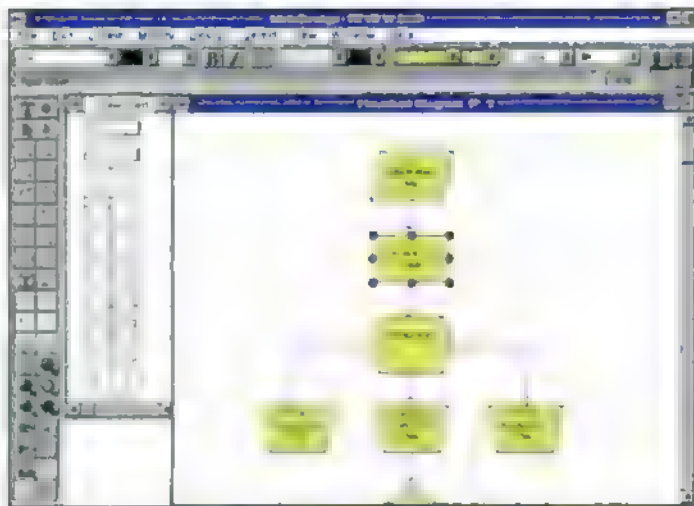
Meta Software

MetaDesign

BY EDWARD MENDELSON

Meta Software's \$199 MetaDesign 4.0 offers little of the elegance or automation in such packages as ABC FlowCharter and Visio, but it's a good and sensible product that creates multipage flowcharts and organization charts with a minimum of fuss. It comes with only nine shape palettes, but a quick click on a menu option lets you convert any shape you create into a custom palette. For these shapes, you can use any drawings created with the program's drawing tools or imported through the Windows Clipboard. You can also import WMF files. Many of the design and navigation tools seem primitive compared with rival packages, but they're straightforward and efficient.

MetaDesign's interface consists of the standard combination of a small palette and a larger drawing area. You can keep multiple palettes and pages on-screen at the same time, but not multiple documents. To draw squares, ellipses, connectors, and free-form polygons and arcs, you click on a button and then click and drag inside the drawing area. You position connectors by hand, although you can use group positioning commands to achieve simple alignment of nodes and connectors. To create a branched connector, you fake it by superimposing two one-to-one connectors over each other.



MetaDesign uses a standard toolbar for basic shapes as well as a separate palette for specialized shapes.

Using toolbar buttons, you toggle between modes for entering text and manipulating shapes. The program minimizes the annoyances of this modal design by letting you create a shape even while the text button is switched on, and then automatically positioning the cursor inside the shape for text entry.

THE DIAGRAMMING PILOT

To create a multipage chart, you can simply add pages or select a node and identify it as the jumping-off point to a child page. Navigation through parent and child pages can be mildly confusing. If you close one or more pages by

clicking on the control menu of each page's window, nothing on screen shows you how to open the page again, or even indicates that the page still exists. To find the invisible pages, you click on the Page Structure diagram button, which fills the screen with an abstract diagram in which each page is represented by a small, labelled dot. And if you move the mouse in the wrong direction, these dots disappear off the screen borders.

Connectors move with nodes, and individual nodes can be marked as anchors so that groups of other nodes move when you move the anchor. It's easy to select some or all nodes or connectors and make wholesale changes. But changes in the button layout and background grid spacing require manual editing of an .INI file. Printer output can be scaled to fit the page, and a Show Page feature doubles as a print-preview feature.

The nine palettes support standard ANSI, network, flowchart, chemical, dataflow, Booch, and other standard diagrams. You don't get simulations, a spell-checker, or support for rotated text. The package supports OLE 1.0, and you can only import Clipboard contents, text files, and .WMF graphics, and export .WMF and .BMP graphics. MetaDesign's diagrams won't be visually dazzling, but if you need to create thousand-page flowcharts, it gets the job done.

MetaDesign 4.0. List price: \$199. Requirements: Microsoft Windows 3.1, 3MB RAM, 2MB hard disk space. Meta Soft-

ware Corp., 125 CambridgePark Dr., Cambridge MA 02140; 800-227-4106, 617-576-6920; fax, 617-661-2008; e-mail, design-tech-support@metasoft.com.

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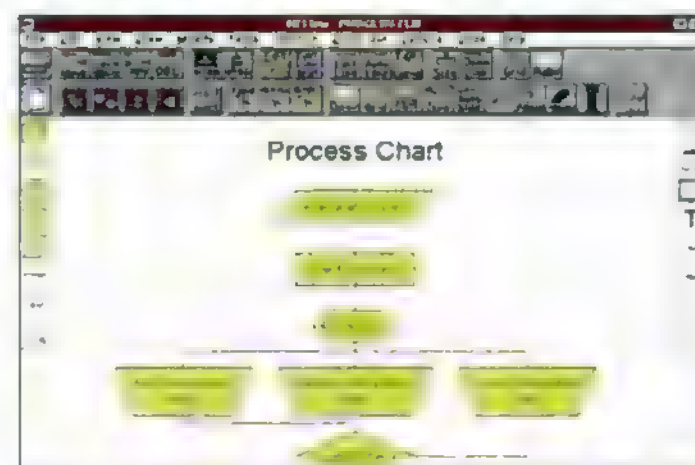
RFF Electronics

RFFlow

BY CRAIG STINSON

RFFlow 3.01 can generate basic flowcharts, but it forces you to grapple with a rather difficult interface—one that's peculiarly out of tune with prevailing Windows standards. Nearly all editing operations require you to choose a command first and then point to an object. The package's principal virtue, compared with most competing products, is its \$129 list price. Since our last flowcharting evaluation, RFFlow has added such features as OLE 1.0 (server) support and a shape editor, but the package still lacks polish.

RFFlow supplies more than 825 symbols and shapes in 33 libraries, covering such functional areas as auditing computers, electrical schematics, industrial objects, transportation, and, of course, stan-



RFFlow lets you choose shapes and commands from customizable button bars and tool boxes.

dard flowcharting. There is a shape editor—new in this version—for adding custom shapes to the library, but it requires you to program the shape you want to create by specifying coordinates and line lengths. You can import .BMP and .WMF file formats.

To place a shape on the diagram, you first click on it in a toolbox. A dialog box then appears, and there you type any text to be associated with the shape and click on an options button to make any desired changes to the shape's formatting attributes. The shape expands to accommodate whatever text you give it (although you

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CorelFLOW

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1,000	0	0
1,000	0	0
100	0	24
256	24	16.8 million
39	11	15
8/7	9/9	1/1
91	22	25

EASE OF USE

- ▶ "Drag and drop" symbols
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- ▶ Auto-resize symbols to fit text
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DIAGRAMMING FEATURES

- ▶ OLE 2.0 server
- ▶ Create customized symbols
- ▶ Draw symbols
- ▶ Save customized symbols to library
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- ▶ Diagram linking
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can also freeze the size of shapes). Once you press Okay in the dialog box, you click on the drawing canvas to position the shape. Objects snap to a grid of user-definable coarseness.

Connecting shapes with lines is a matter of clicking on an icon, then clicking successively on the shapes to be connected. If the shapes involved are not conveniently positioned (for example, if there are too many intervening objects), the program displays an error message and asks you to solve its problem.

ALIGNED AND MALIGNED

Optional alignment commands make it easy to line shapes up at the time you create them. After the fact, RFFlow is far less accommodating. If you need to reposition sections of a diagram after you've gotten most of the elements in place, you must choose between a standard Move command and a Locked Move command, neither of which is entirely satisfactory. The standard Move command moves an item (or a block of contiguous items) without affecting the rest of the diagram. Text within moved shapes goes along for the ride, but everything else has to be adjusted by hand.

SUITABILITY TO TASK

RFFlow

	Power	Ease of use
Chart manipulation	Fair	Poor
Integration/Programmability	Fair	Fair
Output	Fair	Fair

On the other hand, the print-preview feature includes yet another Move command, this one a handy tool for repositioning the entire diagram relative to the page boundaries.

With RFFlow, you can work with only one document at a time, but you can run multiple instances of the program. You can link diagrams with one another, and export objects or entire diagrams in .WMF format.

RFFlow does the basics, but does them inelegantly and causes considerable vexation in the process.

RFFlow 3.01. List price: \$129. Requirements: Microsoft Windows 3.1, 4MB RAM, 2MB hard disk space. RFF Electronics, 1053 Banyan Ct., Loveland, CO 80538; 970-663-5767; fax, 970-669-4889.

Circle 450 on reader service card

Kaetron Software Corp.

TopDown Flowcharter 4.04 for Windows

BY CRAIG STINSON

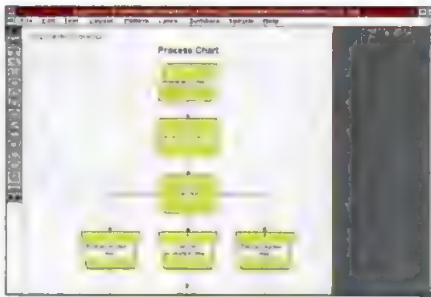
TopDown Flowcharter 4.04 for Windows began life as a Macintosh flowcharter, and its principal strength remains its ability to generate diagrams that can be viewed and edited either in Windows or on the Mac. The cross-platform capability is limited: The Macintosh version can't read the bitmaps and metafiles that may be imported into the Windows version. Otherwise, TopDown Flowcharter is the charter of choice for those who need to work in both environments.

Evaluated strictly as a Windows product, TopDown's high price (\$345) and modest feature set put it at a disadvantage. It has a minimal symbol library along with tools for adding straight lines and floating text. You can link symbols to subordinate diagrams, and you can attach explanatory notecards to symbols. Selecting a symbol and pressing Ctrl-T displays its notecard.

TopDown's symbol library includes 12 standard flowcharting shapes, 24 rectangles with various kinds of icons attached (depicting such things as a telephone, man, woman, rubber stamp, and airplane), and 24 node connectors to facilitate network diagramming. The icons, which you may tailor with a supplied fat-bit editor, sit atop and remain glued to their associated shapes.

SYMBOLIC TASKS

In addition to the supplied symbols, there are 48 custom-symbol slots. Double-clicking any of these puts you in a special edit mode, where a polyline drawing tool helps



TopDown Flowcharter presents a minimal symbol set in a rotating toolbar docked at the left side of the screen.

you create the symbols you need. In this edit mode, as well as on the main diagram, you can paste bitmaps and metafiles from the Clipboard. In our tests, however, we were able to paste bitmaps only in 16-color and 256-color display modes. At higher color depths, pasting bitmaps either crashed the program or did nothing. (Pasting files in .WMF format worked fine.)

To populate a diagram, you click on a symbol, then click or drag on the canvas. By default, the system connects the current symbol with the previous one and leaves you in text-entry mode so that you can type the current symbol's descriptor. Of course, you can turn the automation off and connect everything manually. Lines and text move appropriately as you rearrange your diagram, but you'll need to reconnect the lines yourself if you set a new symbol down

SUITABILITY TO TASK

TopDown Flowcharter

	Power	Ease of use
Chart manipulation	Fair	Fair
Integration/Programmability	Fair	Fair
Output	Good	Fair

in the path between two existing ones.

TopDown can export diagrams as Windows Metafiles (.WMF format) and notecards as text files. For the Windows-to-Mac-and-back connection to work well, the import and export options on both platforms should be expanded. Unless dual-platform support is crucial, there's not enough functionality in TopDown to warrant its relatively high price.

TopDown Flowcharter 4.04 for Windows. Price: \$345. Requirements: Microsoft Windows 3.1, 4MB RAM, 3MB hard disk space. Kaetron Software Corp., 25211 Grogans Mill Rd. #260, The Woodlands, TX 77380; 800-938-8900, 713-298-1500; fax, 713-298-2520; home page, <http://starbase.neosoft.com/~kaetron>, kaetron@neosoft.com.

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Shapeware Corp.

Visio

BY EDWARD MENDELSON

Shapeware's Visio 3.0 (\$199) is an elegantly simple package that lets casual users create complex charts of almost every imaginable kind—and yet it's also a high-powered programming

SUITABILITY TO TASK

Visio

	Power	Ease of use
Chart manipulation	Good	Excellent
Integration/Programmability	Excellent	Excellent
Output	Excellent	Excellent

tool for creating automated charts and templates with active links to external files. It suits both beginners and advanced users well.

Visio's efficient interface, which includes the standard toolbar, palette, and drawing area, lets you keep one or more shape palettes open on screen. You drag shapes from the palette (the stencil, in Visio parlance) and drop them on the drawing area. And if you push the connector button on the toolbar, the program automatically draws a connector between the new shape and the shape you inserted (or selected) previously.

Many shapes come with sets of built-in connector points as well as sizing handles. Connecting lines automatically lock on to the nearest connector point on a shape, but if you move the shape across the page, the program is smart enough to switch the connecting line to a different connector point in order to maintain the shortest path for the line. Branched lines are as easy to use as one-to-one connectors.

You can customize shapes, lines, and text through detailed menus (all equipped with extensive help), through pop-up option lists on the status bar, or through toolbar buttons that cycle through line, arrowhead, and shadow styles. Intuitive tools let you rotate shapes or insert text fields with the current time and other automatically generated data. The stencils include Master-Shapes, which you can customize and save. Advanced users can drill down to a spreadsheet-style interface in which shapes and their automated behavior are defined with mathematical exactness.

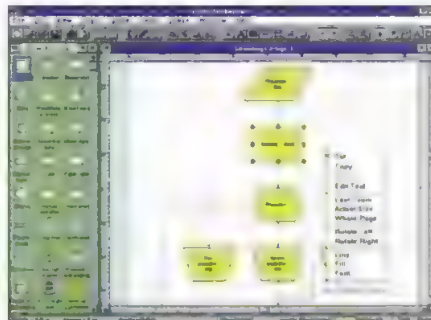
THE SHAPE OF THINGS

Visio ships with 22 stencils, most of them designed for standard business charts. You can protect individual shapes from being deleted or printed, and a variety of constraints control resizing and other behavior. Specialized add-on shape

packages are available from Shapeware. You can attach help text to shapes and use a shape as a jumping-off point to another page. Import filters let you create shapes or drawings based on files in all standard formats, and you have the same flexibility in export. Printing and scaling controls are elaborate, document summary fields contain room for descriptions of a chart, and the File Open dialog box shows a long name and full description.

Full client and server OLE 2.0 support makes Visio act like an integral module of Excel, Word for Windows, and WordPerfect. Two reduced versions of the package, Visio Express for Microsoft Office and Visio Express for Lotus SmartSuite (each \$79), integrate smoothly into Microsoft's and Lotus's application suites. Also available are Visio Technical (\$349) and Visio Home (\$79), both with specialized templates and shapes.

In our last flowcharting evaluation,



Visio's colorful, informative screen has an option to label all palette shapes. A right-click pop-up menu appears at the right.

Visio was in its first version, and the two subsequent versions have seen the addition of OLE 2.0 and improved stencils. Visio doesn't have everything—it lacks the automatic crossover points and collision-avoidance found in ABC Flowcharter—but its overall flexibility, ease, and intelligence combine to make it an extremely impressive program. □

Visio 3.0. List price: \$199. Requirements: Microsoft Windows 3.1, 4MB RAM, hard disk space: 5MB minimum, 15MB maximum. Shapeware Corp., 520 Pike St. #1800, Seattle WA 98101; 800-446-3335, 206-521-4500; fax, 206-521-4501; CIS: Go Visio.

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VB Power



ISBN: 1-56276-073-4
Price: \$34.95

This innovative guide by Dan Appleman turns Visual Basic programmers into power users by illuminating the tools of the Windows Application Program Interface (API). Includes a time-saving disk that contains source code from the examples in the text, plus a specially designed dynamic link library (DLL).



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The Versatile NETWORK OPERATING SYSTEM

A new wave of network operating systems rolls in. But will these NOSs replace or complement the one you're with now?

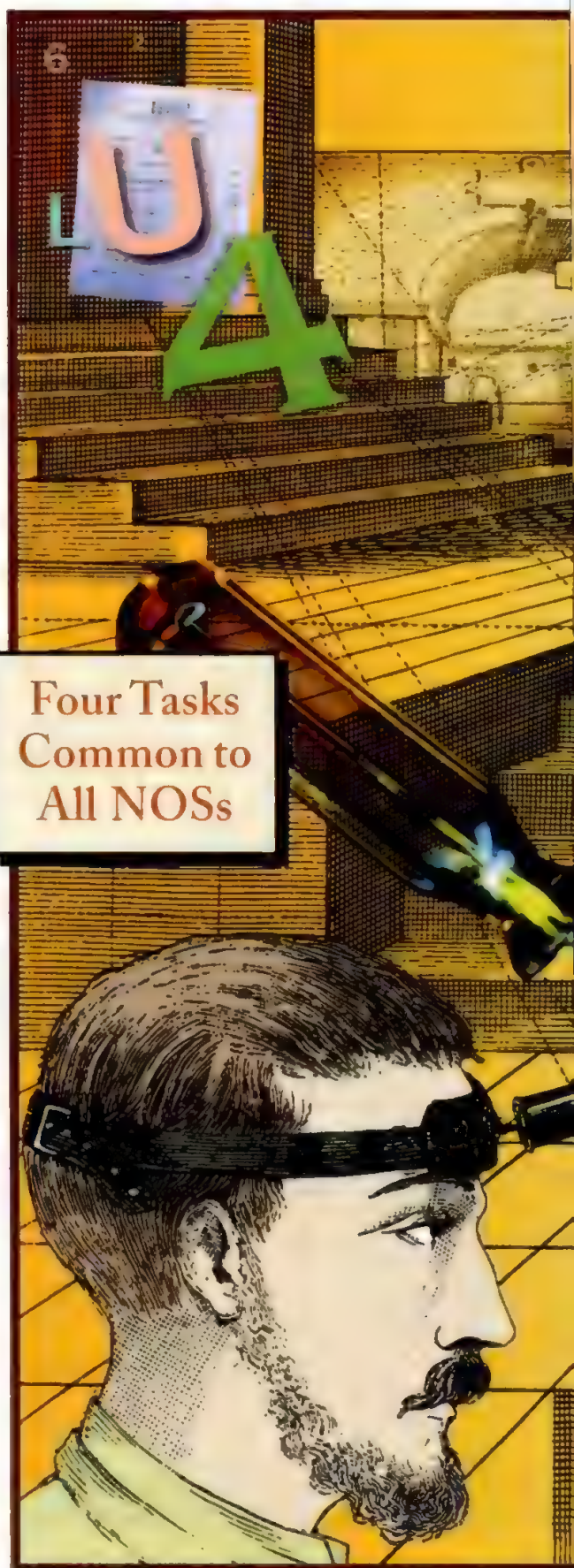
NetWare 3.x managers are in a win-win situation. Not only are they using the industry's most popular network operating system, but if they are ready for a change, they'll find that every NOS company in this roundup—Banyan, IBM, Microsoft, even Novell itself—has bent over backward to make sure it has a migration path from NetWare 3.x.

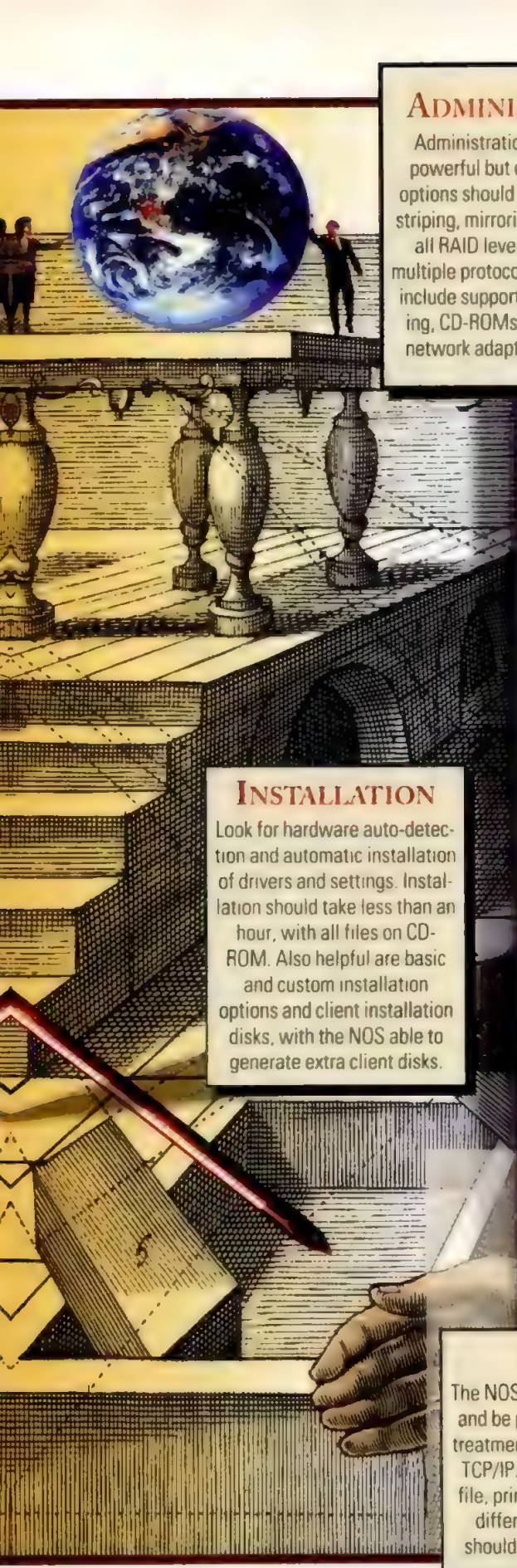
Why would anyone think about moving away from the most popular network operating system of the 1990s? The answer is growth. Though file and print services still provide the bread-and-butter functions of a server, companies increasingly want their LANs to provide platforms for client/server

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Four Tasks
Common to
All NOSs





ADMINISTRATION

Administration tools must be powerful but easy to use. Disk options should include spanning, striping, mirroring, duplexing, and all RAID levels. In addition to multiple protocols, the NOS should include support for multiprocessing, CD-ROMs, backup devices, network adapters, and printers.

INSTALLATION

Look for hardware auto-detection and automatic installation of drivers and settings. Installation should take less than an hour, with all files on CD-ROM. Also helpful are basic and custom installation options and client installation disks, with the NOS able to generate extra client disks.



DIRECTORY SERVICES

Services should be global and open to developers via APIs; they should also provide a single log-on to a large multi-server network. The ability to assign hierarchical management responsibilities and maintain a distributed directory database across the network is vital.



INTEGRATION

The NOS must integrate with NetWare 3.x and be protocol-independent, with equal treatment of AppleTalk, IPX, NetBEUI, and TCP/IP. Clients should be able to access file, print, and application resources on a different NOS easily. All client types should integrate well within each NOS.

and messaging applications and directory services for multiple servers—without sacrificing integration with the existing system. Many network managers don't believe NetWare 3.x's architecture is ready for this next-generation functionality. Fortunately, a whole new breed of network operating system has arrived, and it offers solutions for today as well as some interesting promises for tomorrow.

BEYOND FILE AND PRINT

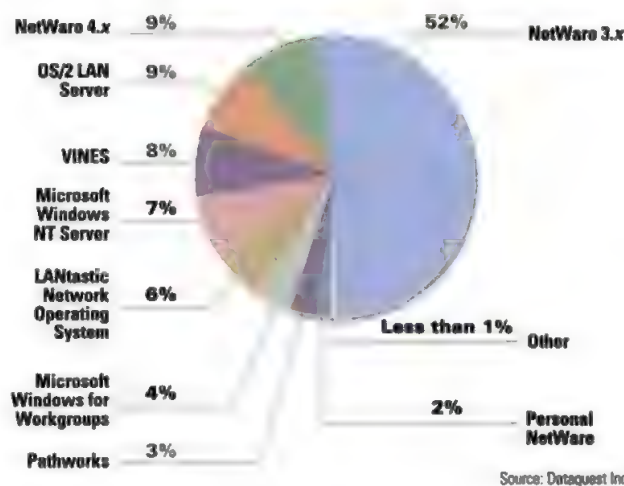
Traditional file and print services have almost become commodities in terms of performance; application services are beginning to differentiate NOSs. By application services, we do not mean a word processing package on a centralized server; instead, we mean database, messaging, or communications programs running on the server that interact with related programs on the clients in a distributed fashion.

A good application server depends on speed, reliability, and scalability. At this point it's still difficult to test application services in any meaningful way across the various platforms, but by later this year there should be enough applications available to really pit one NOS against another in the application-server arena. We're not suggesting impending doom for all mainframe or Unix-based applications. But we do believe that workgroup and departmental applications can begin to reside on the same NOS that handles your file services (or you can add specialized services to run these applications). But in order to do this, you'll need to expand beyond NetWare 3.12.

NetWare 4.1 has an improved capability to run applications on the server, but some questions about its reliability remain. These concerns, combined with the lack of multiprocessor support until later this year, limit the effectiveness of NetWare 4.1 as an application server. Strategists at Novell are relying on UnixWare as their application platform; they have described plans to integrate NetWare and UnixWare. But today,

NETWARE: Clear Market Leader

Novell continues to command more than 60 percent of the NOS market, based on the number of user licenses sold for PC-based NOSs in 1994 (both server-based and peer-to-peer).



they clearly want NetWare 4.1 to be the successful network operating system on the Intel platform.

The lead positions in the application-server arena go to Microsoft Windows NT Server 3.5 and OS/2 2.11 for SMP because of their 32-bit, preemptive multitasking, multithreading environments; memory protection; and multiprocessor capabilities. SCO Open Server Enterprise System 3.0 with MPX (see the side-

NOS views the network as a single entity or as a collection of pieces. In addition, robust *directory services* facilitate messaging and groupware applications throughout your company. As networks expand with administrators adding more servers and more applications, the underlying intelligence in the directory services becomes more important.

Enterprise network operating systems such as NetWare 4.1 and VINES are at the forefront in offering powerful *global directory services* for organizing your network. Close behind are OS/2 LAN Server 4.0 and Windows NT Server, which take a somewhat differ-

ent approach called *domain directory services*. (See the sidebar "Advanced Network Services.") NetWare 3.12's dated *bindery services*, localized on single servers, function best in environments with a small number of servers. Those with medium- to large-size networks may find directory services a compelling reason to upgrade.

SOMETHING OLD, SOMETHING NEW

The transition to a new network operating system is not made overnight. The idea is to extend your network incrementally, and often this means maintaining your old network along with your new network.

Each NOS vendor has an approach for integrating its product with existing architectures. For some, integration means using the same network protocols. (For example, Microsoft has developed an IPX-compatible protocol, NWLink, to help integrate Windows NT into NetWare's native IPX environment.) For others, integration means using the same upper-layer file-access protocols for file sharing, such as the use of Server Message Block (SMB) in LAN Server and Windows NT Server.

Also, be aware of where the integration occurs—at the client or the server. Client-based integration means that multiple programs are running on one PC at the same time. This technique has histori-

*A whole new
breed of NOS has arrived,
and it offers advanced
services for today
and interesting promises
for tomorrow.*

bar "Why App Servers Are Hot") can also serve as an application server, but SCO Open Server didn't scale as well in our testing and doesn't provide the same quality of file and print services as the other NOSs we review.

BEYOND THE SINGLE SERVER

The effort required to administer a network is in part related to whether the

cally failed due to memory limitations of the host operating system, typically DOS. (See the sidebar "Client/Server Meets the LAN.") Certainly, there are other considerations. In the course of our reviews we look at installation, usability, and administration tools as well as file and printer resources.

THE REAL COST OF THE NOS

You can't underestimate your current networking environment as a factor in determining your next move. Shops with tight budgets will like the pricing of LAN Server and Windows NT Server. Current OS/2 shops will find LAN Server appealing. Those committed to Windows NT on the desktop will want Windows NT Server, a robust platform with a familiar interface that is extraordinarily easy to install. NetWare 4.1 offers an easy upgrade path for existing NetWare shops, although integrating Novell's NetWare Directory Service (NDS) with the NetWare 3.12 bindery is still a chore. Larger shops need to evaluate costs, the relative advantages of global directory services over domain directory services, and their own growth plans. To help you muddle through figuring the cost of a network, we put together a comprehensive pricing analysis of the different products (see the Price Comparison table).

We believe upgraders should look first to their own vendors for a migration path. Version 5.54 of VINES is a relatively minor upgrade that supports some additional hardware beyond Version 5.52 (reviewed in "Playing the Odds," October 26, 1993). LAN Server 4.0 offers LAN Server users a brand-new graphical interface and a slick new shell for DOS clients. Also, the beta of IBM's new client software, OS/2 Warp Connect, seems very complete and well integrated.

Version 3.5 of Windows NT is an easy upgrade that fixes the bugs in the initial 3.1 release, requires less server memory,

• NetWare 4.1

Two years after NetWare 4.0's release, Novell has gotten it right. NetWare 4.1's directory services, integrated network management utility, improved manage-

ment facilities, and much-improved installation make this newest NetWare release our Editors' Choice.

Microsoft Windows NT Server 3.5 is in many ways a match for NetWare 4.1 and merits an honorable mention. Both products offer clear management and administration utilities, and both include strong disk management facilities. NetWare 4.1 offers file compression, block suballocation, and data migration. (The first two increase disk capacity; the last is integral to transparent hierarchical storage management.) Windows NT, on the other hand, offers hassle-free installation and is superior as an application-server platform.

So why did we give the nod to NetWare 4.1? Quite simply because of Novell's NetWare Directory Services (NDS), a distributed database of network resources that provides a single point of management. Novell cleaned

up a lot of the initial problems with NDS, so ongoing management of the directory tree can be done effectively as your organization changes. No other directory services system is as robust. NDS is also extensible: Developers can add both objects and attributes for network applications.

Of the other products, the two flavors of IBM's OS/2 LAN Server 4.0 stand a notch behind NetWare 4.1 and Windows NT. LAN Server 4.0 did, however, offer an innovative GUI-like shell for DOS, better management than earlier versions, and much-improved installation. Banyan's VINES 5.54 hasn't kept up with the competition: Installation was long, and management was arcane and difficult despite effective directory services. NetWare 3.12 remains a stable, reliable, and solid network operating system; but given the presence of more powerful alternatives, we think it's best suited for the workgroup.



and offers other enhancements. In addition, Microsoft has introduced a complex plan for licensing clients for different services. NetWare customers with multiple servers should look to NetWare 4.1 to reduce administrative overhead. Those with fewer servers will probably find it less imperative to upgrade.

For application services, you'll want to look closely at Windows NT Server and LAN Server. For directory services, pay special attention to NetWare 4.1 and VINES. Multivendor network shops

using a combination of NetWare, Windows NT, and Unix may want to take a look at Banyan's Enterprise Network Services (ENS). ENS provides a global directory service for NetWare 2.x and 3.x networks, something even Novell doesn't offer. Banyan plans to expand this service to Windows NT networks.

REVIEW CRITERIA

To be included in the main roundup, a product had to offer a high-performance, 32-bit, PC-based server operating system, file and print services, and some kind of multiserver directory services for simplifying the management and administration of multiple servers. This netted us four products: Microsoft Windows NT Server 3.5, Novell's NetWare 4.1, IBM's OS/2 LAN Server 4.0, and Banyan's VINES 5.54. We also de-

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WITH NETWORK INTEGRATION.

WITH HOST CONNECTIVITY AND MESSAGING.

WITH FILE AND DATABASE
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EXHAUSTED.

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WHERE DO YOU WANT TO GO TODAY?™

▪ Client/Server Meets the LAN

By Robert P. Lipschutz

It won't be easy integrating client/server architecture into your existing network. But there are three solid reasons for pushing ahead with integration:

- As on the desktop, applications drive the acceptance of an underlying operating system. Windows pushed aside DOS because its applications were more compelling. Similarly, your company may benefit from running an important Windows NT or OS/2 application even though your file and print servers run NetWare.
- You may not have any choice but to integrate, because of departmental or company mergers, consolidation, or moves. A department happily running OS/2 LAN Server may be merged with one running NetWare—and something's got to give.
- If you decide to change or upgrade network operating systems (even if it's to upgrade one file-and-print services NOS with another), it's unlikely you'll go cold turkey. More often, there'll be a period of coexistence.

BAD NEWS: TRAINING COSTS

What's it like to use two or more network operating systems? It's both better and worse than you think. Perhaps the most important consideration is the management-training costs you'll incur when you bring a new platform into the mix. Whether you hire outside consultants or use inside talent, you'll rarely find an expert who knows two platforms equally well. In general, your network administrators will also

require two separate suites of management software. Existing hardware and software, such as network backup, might not work with a new NOS platform. Users will feel the burden of finding new tricks to get to new resources. And finally, since Novell prices its products per server while IBM and Microsoft price per client, you may end up paying more than you'd like.

GOOD NEWS FOR NETWARE 3.X USERS

The good news is that Microsoft (and to some extent IBM) has made integration with NetWare 3.x easier. Gone are the days when vendors told you to run dual protocol stacks on your clients. This never worked well and

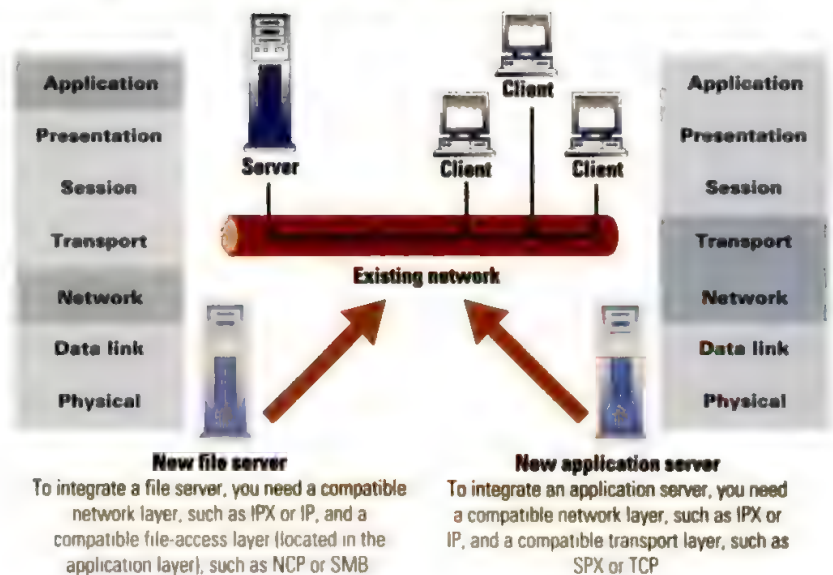
was a time-sink until you got it up and running.

New, more powerful desktop operating systems such as Microsoft Windows NT Workstation, Windows 95, and OS/2 Warp Connect—with their improved memory architectures and network protocol stacks—handle multiple stacks better, but there are still hassles. Fortunately for today's DOS and Windows clients, integration products sit on servers; clients remain untouched.

THE DETAILS OF INTEGRATION

You can break integration into two parts: integrating application services and integrating file services. Here are the technical details:

Integrating File and Application Services



cided to include NetWare 3.12 despite its lack of directory services, because it is the de facto standard for traditional file-and-print servers.

Novell's UnixWare was not reviewed because the new version, 2.1, was not shipping. Digital Equipment Corp.'s Pathworks does not provide native file services for Intel platforms. SCO Open Server lacks distributable directory ser-

vices, but we included it in our multiprocessing performance tests. Both UnixWare and SCO Open Server are targeted for application services rather than classic file-and-print services.

BEYOND BENCHMARK TESTING

Although performance is always a much-debated issue, it can sometimes overshadow other important criteria. Our

suitability to task ratings—which rank the products on key features such as installation, administration, directory services, and integration—are just as critical to making a good NOS decision.

Administration tools are defined as the process of specifying users, groups, and other network capabilities and resources, such as printing and printers, and establishing security and access privileges.

In modern client/server applications, programs send messages across the LAN by talking directly to the network and transport protocols—entirely bypassing the Open Systems Interconnect's (OSI) upper-layer file-access protocols (see the diagram). The file-requester protocol (NCP in the case of NetWare) isn't involved. So when you integrate new application-server operating systems into the LAN, you need only make sure that the transport and network protocols are compatible. For NetWare, this implies IPX and SPX.

File services rely on the network-layer protocol and the upper-layer file-access protocol. In the case of NetWare, this implies IPX and NCP. Typically, the transport-layer protocol is unused for file services.

MICROSOFT AND IBM

Microsoft has a host of NetWare-integration products, and interoperability between Microsoft and IBM network products comes automatically. Microsoft provides good integration among Windows NT Workstation and Windows 95 clients and NetWare 3.x servers with NWLink, its new IPX/SPX-compatible protocol.

But NWLink isn't in Windows for Workgroups. You still have to supply a copy of Novell's NetWare client software, and it doesn't integrate into WfWG as well as NWLink does into Windows NT Workstation or Windows 95.

IBM does not have an IPX/SPX-compatible transport, so NetWare clients need to add Server Message Block (SMB) and NetBIOS or TCP/IP along side of IPX to access LAN

Server-based applications, which can burn up memory on DOS and Windows clients.

If you have NetWare client software loaded in your PCs, you can add a Windows NT server by using Microsoft's File and Print Services for NetWare, an optional product currently in beta testing. Microsoft has emulated Novell's NCP protocol on Windows NT Server and even Novell's own administration utilities (such as System Console and Print Console) run fine. It's as if Microsoft replaced a real NetWare server with an impostor. We were not able to test the performance of this product, as it wasn't expected to ship until mid-spring 1995. IBM does not have any similar NetWare-emulation product at this time.

Conversely, if you already have Windows NT servers and are trying to add a single NetWare server, your native DOS and Windows clients can access NetWare servers through Microsoft's Gateway Service for NetWare. The gateway, running on a Windows NT server, translates client SMB calls to NCP requests understood by NetWare servers. A single log-on gives users access to both Windows NT Server and NetWare resources. Expect to pay a performance penalty, since the Windows NT server must act as an intermediary on all file and print requests.

Finally, both IBM and Microsoft provide a migration utility that eases the move from NetWare. The process still takes a lot of work, but the utility makes migration less onerous. Sometimes, especially in complicated networks, it makes sense to start over from scratch. □

Management tools go beyond administration to handle the addition of devices and services, as well as monitoring and troubleshooting the network.

LAN Server, NetWare 4.1, and Windows NT Server have graphical interfaces for their utilities; VINES offers only a DOS-based utility; and NetWare 3.12 has some limited Windows and Macintosh utilities, but most are DOS-based. Be-

cause printing requires the integration of server, client, and application, the process is complex. Printing services for DOS and Macintosh clients remain perhaps the most challenging tasks for a NOS; the former because DOS applications all do things their own way, and the latter because of the inherent difficulty of integrating fundamentally different printing paradigms.

Each of the NOSs allows managers to handle basic administrative and security services, such as adding users and assigning privileges. Beyond that they differ widely, and part of your choice will be motivated by your organization. For example, universities that must generate hundreds or thousands of user IDs regularly will probably find NetWare 4.1 the easiest to use. When it comes to monitoring utilities, NetWare 3.12 and VINES are probably the least impressive. All of the products would benefit from better reporting utilities.

CLIENT SUPPORT

Who is responsible for connecting clients to network servers—the client operating system vendor or the NOS vendor? This is another part of the networking quandary. For example, none of the NOSs except VINES offer specific client software for Windows NT Workstation, but Windows NT Workstation has built-in networking to connect to each of them.

Macintoshes require only a server component (either bundled or offered optionally by all the vendors), because the Macintosh operating system includes AppleTalk networking. Windows for Workgroups has built-in Microsoft networking. Windows 95 and OS/2 Warp Connect promise a wide range of client networking features for various server operating systems; they will be available soon. Generally speaking, the hardest part of setting up the clients is trying to figure out which ones depend on the NOS, which ones don't, and which client software to choose when a choice is available. All the vendors did include some method for generating and installing the software for the clients they supported.

SERVER SETUP AND CONFIGURATION

Nobody expects setting up a NOS to be easy, but installation programs offer us clues about vendors' attitudes toward making management simpler. Setup and configuration consist of starting the installation program, defining network parameters, setting up volumes and disk options such as mirroring or RAID, transferring the operating system from the distribution medium to the server, and

Network Operating Systems

PRICE COMPARISON

One factor to consider when purchasing a NOS is whether the vendor's pricing model allows all clients to access all servers, or whether each server restricts the number of concurrent clients. Only Novell currently prices for concurrent users. (Our chart assumes that each client will access all servers.)

Be aware that the price of the NOS is a fraction of the total cost of operating your network. Client OSs, hardware, administration, and maintenance can be far more expensive than the NOS itself. In this chart, we give the estimated street price and approximate cost per client of the reviewed NOSs with different configurations.

	Microsoft Windows NT Server 3.5 ¹		NetWare 3.12		NetWare 4.1		OS/2 LAN Server 4.0 Entry ¹		OS/2 LAN Server 4.0 Advanced ¹		VINES 5.54	
	Street price	Cost per client	Street price	Cost per client	Street price	Cost per client	Street price	Cost per client	Street price	Cost per client	Street price	Cost per client
5 clients												
1 server	\$899	\$180	\$679	\$136	\$679	\$136	\$683	\$137	\$1,663	\$333	\$1,947	\$389
25 clients												
1 server	\$1,468	\$59	\$2,291	\$92	\$2,291	\$92	\$1,333	\$53	\$2,313	\$93	\$5,198	\$208
2 servers	\$1,873	\$75	\$4,582	\$183	\$4,582	\$183	\$1,853	\$74	\$3,813	\$153	\$5,198	\$208
5 servers	\$3,445	\$138	\$11,455	\$458	\$11,455	\$458	\$3,413	\$137	\$8,313	\$333	\$5,198	\$208
50 clients												
1 server	\$1,999	\$40	\$3,097	\$62	\$3,097	\$62	\$2,145	\$43	\$3,125	\$63	\$5,198	\$104
2 servers	\$2,523	\$50	\$6,194	\$124	\$6,194	\$124	\$2,665	\$53	\$4,625	\$93	\$5,198	\$104
5 servers	\$4,095	\$82	\$15,485	\$310	\$15,485	\$310	\$4,225	\$85	\$9,125	\$183	\$5,198	\$104
100 clients												
1 server	\$3,299	\$33	\$4,337	\$43	\$4,337	\$43	\$3,770	\$38	\$4,750	\$48	\$6,497	\$65
2 servers	\$3,823	\$38	\$8,674	\$87	\$8,674	\$87	\$4,290	\$43	\$6,250	\$63	\$6,497	\$65
5 servers	\$5,395	\$54	\$21,685	\$217	\$21,685	\$217	\$5,850	\$59	\$10,750	\$108	\$6,497	\$65
10 servers	\$8,015	\$80	\$43,369	\$434	\$43,369	\$434	\$8,450	\$85	\$18,250	\$183	\$6,497	\$65
250 clients												
1 server	\$7,199	\$29	\$7,747	\$31	\$7,747	\$31	N/A*	N/A*	\$9,625	\$39	\$9,747	\$39
2 servers	\$7,723	\$31	\$15,494	\$62	\$15,494	\$62	N/A*	N/A*	\$11,125	\$45	\$9,747	\$39
5 servers	\$9,295	\$37	\$38,735	\$155	\$38,735	\$155	N/A*	N/A*	\$15,625	\$63	\$9,747	\$39
10 servers	\$11,915	\$48	\$77,469	\$310	\$77,469	\$310	N/A*	N/A*	\$23,125	\$93	\$9,747	\$39
50 servers	\$28,744	\$115	\$387,345 ²	\$1,549	\$387,345 ²	\$1,549	N/A*	N/A*	\$83,125	\$333	\$9,747	\$39
500 clients												
1 server	\$13,199	\$26	N/A**	N/A**	\$15,497	\$31	N/A*	N/A*	\$17,750	\$36	N/A***	N/A***
2 servers	\$13,693	\$27	N/A**	N/A**	\$30,994	\$62	N/A*	N/A*	\$19,250	\$39	N/A***	N/A***
5 servers	\$15,175	\$30	N/A**	N/A**	\$77,485	\$155	N/A*	N/A*	\$23,750	\$48	N/A***	N/A***
10 servers	\$17,695	\$35	N/A**	N/A**	\$154,969	\$310	N/A*	N/A*	\$31,250	\$63	N/A***	N/A***
20 servers	\$22,585	\$45	N/A**	N/A**	\$309,938 ²	\$620	N/A*	N/A*	\$46,250	\$93	N/A***	N/A***
50 servers	\$34,494	\$69	N/A**	N/A**	\$774,845 ²	\$1,550	N/A*	N/A*	\$91,250	\$183	N/A***	N/A***
1,000 clients												
1 server	\$23,699	\$24	N/A**	N/A**	\$29,757	\$30	N/A*	N/A*	\$34,000	\$34	N/A***	N/A***
2 servers	\$24,154	\$24	N/A**	N/A**	\$59,514	\$60	N/A*	N/A*	\$35,500	\$36	N/A***	N/A***
5 servers	\$25,519	\$26	N/A**	N/A**	\$148,785	\$149	N/A*	N/A*	\$40,000	\$40	N/A***	N/A***
10 servers	\$27,794	\$28	N/A**	N/A**	\$297,569 ²	\$298	N/A*	N/A*	\$47,500	\$48	N/A***	N/A***
20 servers	\$32,344	\$32	N/A**	N/A**	\$595,138 ²	\$595	N/A*	N/A*	\$62,500	\$63	N/A***	N/A***
50 servers	\$45,994	\$46	N/A**	N/A**	\$1,487,845 ²	\$1,488	N/A*	N/A*	\$107,500	\$108	N/A***	N/A***
100 servers	\$77,500	\$78	N/A**	N/A**	\$2,975,690 ²	\$2,976	N/A*	N/A*	\$182,500	\$183	N/A***	N/A***

N/A* Not applicable. The vendor does not recommend this configuration.

N/A** Not applicable. The product is not priced for this configuration.

N/A*** Not applicable. The product is available only through a corporate site license for this configuration.

¹ Volume discounts are also available.

² The suggested retail price for Novell's corporate license agreement is \$166 per workstation, it requires a \$160,000 minimum purchase.

setting up the desired protocols. All the NOSs ship on CD-ROMs, and all have a simple installation option that requires answers to only a few questions. All except VINES copy the operating system files in less than 30 minutes; VINES took considerably longer.

The installation routines differed most dramatically in two key areas: pre-installation setup and auto-detection capabilities. The NetWare products require the most up-front effort. For instance, you need DOS, a device driver, and MSCDEX to operate your CD-ROM drive. The other NOSs require you to do little more than attach the CD-ROM drive, put a disk in the A: drive, and know a few hardware parameters.

Windows NT Server raises the bar for easy installation with its auto-detection of all server hardware components, including the hard disk controller, network adapter, CD-ROMs, and even modems.

All of the products support third-party hardware-based RAID (Redundant Array of Inexpensive Disks, an array of hard disks designed to provide protection against disk failures). In addition, they all offer some combination of software-based RAID features: spanning (extending a logical partition over several physical disks), mirroring (duplicating the contents of one hard disk on another), duplexing (duplicating both disk controllers and hard disks), or soft-

ware striping (writing blocks of data across different disks). See the Summary of Features table for details on each NOS's offerings.

In addition to native protocols, we installed AppleTalk and TCP/IP under each of the NOSs. If you understand the protocol options, installation is simple—with the exception of NetWare 3.12, which has a command line interface. Bundled or optional TCP/IP client stacks are available for all the NOSs. Only Windows NT Server, however, currently uses the Dynamic Host Configuration Program (DHCP), a method of assigning TCP/IP addresses from a shared pool. This relieves the network administrator from the onerous task of manually ad-

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CIRCLE 321 ON READER SERVICE CARD

ministering TCP/IP addresses at each client. NetWare 3.12 and 4.1 are the only NOSs where you can load and unload protocols while the server is running, although we wouldn't recommend this during production hours.

USER-FRIENDLY

Perhaps the trickiest area to evaluate is end user support, because there are different models of "friendliness" that exist among network managers. One group's primary objective is to hide the network from the user, keeping them ignorant about drives, servers, or domains and shielding them from the network's structure. The other group wants the network to be visible but also wants it to be as easy as possible for individual, nontechnical users to access network resources. This latter group requires a friendly interface to network resources. All of the NOSs offer tools for both types of managers.

End user support extends to the client, too. Macintosh users access network resources in pretty much the same way they access local resources. Ease of use is a given. All the Intel-based clients (except the DOS ones) include at least the ability to connect to a network drive, provided that the proper client software is installed. For some network managers, these network-friendly, user-friendly clients create a challenge, since their end users are comfortable exploring the network.

VARIETY ABOUNDS

The choices are plentiful and pleasing. We were impressed by LAN Server's new interface and its DOS shell. We were won over by Windows NT Server and LAN Server's ability to run client/server applications efficiently gave us hope for the future of client/server computing. We have considerable respect for Banyan's StreetTalk directory services and its strong enterprise NOS. Finally, Novell has a winner in NetWare 4.1—and it's hard to ignore the installed base and the presence of third-party applications and tools for NetWare 3.12. All of these products have attractive features to offer potential customers. Read on to find out which set of features comes closest to your needs.

Microsoft Corp.

Microsoft Windows NT Server 3.5

BY ROBERT P. LIPSCHUTZ

Do power and ease of use have to be inversely proportional? Not if the product is Microsoft Windows NT Server 3.5. It may lack the market share, breadth and depth of third-party products and the number of knowledgeable network administrators that NetWare 3.12 has, but Windows NT Server is one of the easiest-to-use network operating systems around. And by offering NetWare integration and migration, Microsoft hopes to capture a larger portion of the NetWare gold mine.

Microsoft wants Windows NT Server to be more than a file and print server for your network. This robust and scalable 32-bit multitasking, multithreading NOS provides a solid platform for file, print, application, and other services.

Microsoft's strategy for Windows NT Server is like its desktop strategy: Sell both an operating system and applications. The Windows NT Server application suite, called Microsoft BackOffice, contains Microsoft Systems Management Server for node and application management, Microsoft SNA Server to connect to IBM hosts on an SNA network, and Microsoft SQL Server, a client/server database. A

mail server, Microsoft Exchange, is scheduled to ship in 1995.

INSTALLATION

Windows NT Server makes an excellent first impression. Installation was the easiest of any product we tested, thanks to hardware auto-detection and intuitive configuration steps. Three floppy disks and a CD-ROM are all you'll need; if all of your hardware is supported, Express Setup will have you going quickly. In our testing, the two network adapters, hard disks, and CD-ROM drive were all automatically detected and configured.

More complicated hard disk and volume setups (such as configuring striped, mirrored, and Level 5 RAID volumes) require you to run the easy-to-use Disk Administrator utility. Unlike NetWare, the main system partition can't be extended from its original setting (though other partitions can be).

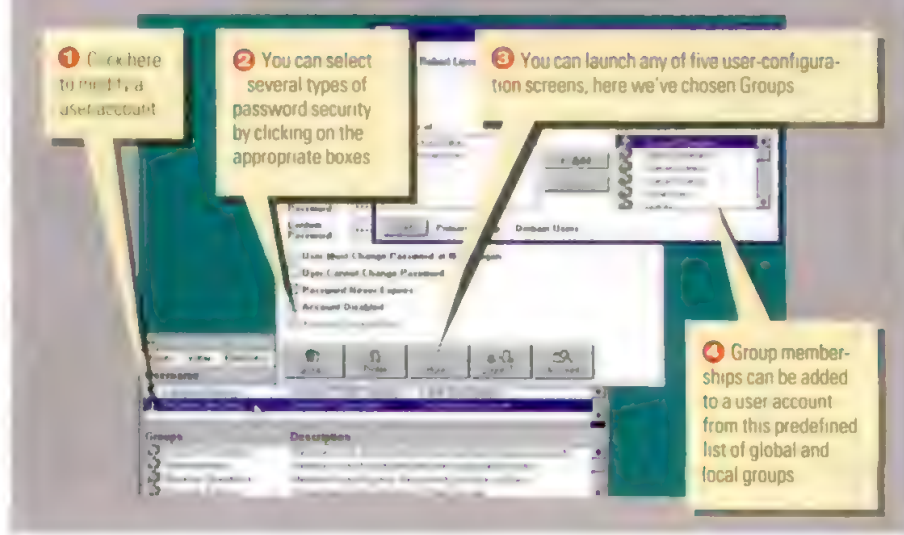
Once Windows NT Server was installed, we proceeded to set up and configure our server with users and groups. A graphical utility called User Manager provides a well-integrated user interface for adding and modifying users and groups. Sharing files—equivalent to granting trustee directory rights and mapping drives in NetWare—is a simple process. Logon scripts, implemented as external text files, could be better integrated.

SUITABILITY TO TASK

Microsoft Windows NT Server 3.5

Installation	Excellent
Administration	Excellent
Directory services	Good
Integration	Good

Microsoft Windows NT Server 3.5: Simple User Administration



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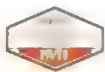
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CIRCLE 267 ON READER SERVICE CARD

SUMMARY OF FEATURES

Network Operating Systems

Continues

PC MAGAZINE
EDITOR'S CHOICE

■ YES ■ NO Products listed in review order	Microsoft NT Server 3.5	NetWare 3.12	NetWare 4.1	OS/2 LAN Server 4.0 Entry	OS/2 LAN Server 4.0 Advanced	VINES 5.54
General Features						
Minimum disk space required	90MB	40MB	75MB	52MB	52MB	80MB
Maximum disk space supported	1,700TB	32TB	32TB	1.5TB	1.5TB	20GB
File systems supported						
FAT	■	■	■	■	■	■
HPFS	■	■	■	■	■	■
NetWare file system	■	■	■	■	■	■
NFS	Optional (via third party)	Optional	Optional	Optional	Optional	Optional (via third party)
NTFS	■	■	■	■	■	■
VINES file system	■	■	■	■	■	■
User can migrate from other NOS	■ (NetWare 3.x)	■	■ (NetWare 3.x)	■ (NetWare 3.x)	■ (NetWare 3.x)	■ (NetWare 3.x)
Server Disk Options						
Data compression/migration	■ ■	■ ■	■ ■	Optional ■	Optional ■	■ ■
Data-block suballocation	■	■	■	■	■	■
Hardware striping	■	■	■	■	■	■
Software striping	■	■	■	Optional (via third party)	Optional (via third party)	■
Spanning	■	■	■	Optional (via third party)	Optional (via third party)	Optional (via third party)
Networked CD-ROM support	■	■	■	■	■	■
CPU Support						
Intel x86	■	■	■	■	■	■
DEC Alpha	■	■	■	■	■	■
Motorola 680x0	■	■	■	■	■	■
Multiprocessing	■	■	■	Optional	Optional	Optional
Multitasking and multithreading	■	■	■	■	■	■
Memory Usage						
Dynamic memory-resource allocation	■	■	■	■	■	■
Maximum cache size	2GB	4GB	4GB	4GB	4GB	100MB
Maximum amount of RAM	4GB	4GB	4GB	4GB	4GB	256MB
Minimum memory requirement	16MB	4MB	8MB	8MB	16MB	8MB
Protected memory (ring 3)	■	■	■	■	■	■
Network Security						
Access to operations by user name and user group	■	■	■	■	■	■
Access-control lists are managed on a per-file basis	■	■	■	■	■	■
Administrator can limit amount of hard disk space	■	■	■	■	■	■
Administrator can require periodic password changes	■	■	■	■	■	■
C2 certification	■	■	■	■	■	■
Offers intruder detection and lockout	■	■	■	■	■	■
Passwords are encrypted when sent across the network	■	■	■	■	■	■
Password restrictions	■	■	■	■	■	■
Network Printing						
Supports printers connected to server	■	■	■	■	■	■
Supports printers connected to workstations	■	■	■	■	■	■
Supports printers connected to network	■	■	■	■	■	■
Protocol Support						
AppleTalk	■	■	■	Optional	Optional	Optional
DHCP	■	■	■	■	■	■
DLC	■	■	■	■	■	■

We did find a few limitations in our testing. The best Windows NT Server clients are, unsurprisingly, Windows NT Workstation and Windows for Workgroups 3.11. OS/2 client software is included but does not work with OS/2 Warp. In addition, browsing Windows NT Server resources from any client can be annoyingly slow. WfWG and Windows NT Workstation let you turn off automatic browsing. To its credit, Microsoft includes 16-bit management apps for Windows 3.1 and WfWG that are almost identical to the 32-bit apps used by Windows NT Server.

As any network administrator knows, groups can greatly ease network management. Windows NT Server defines two types of groups: local and global. For single-domain networks, local groups let you group similar users. In multidomain networks, both groups work together to manage interdomain resource use.

Windows NT Server includes a better-implemented suite of network protocols to connect these clients than any other NOS we looked at. NetBEUI still exists for backward compatibility, but NW-Link (an IPX/SPX-compatible protocol) is a better choice for today's routed networks. Macintosh connectivity is easier than with the other NOSs we reviewed.

Rounding out the standard set of protocols is TCP/IP and the related DHCP and Windows Internet Naming Service (WINS). Windows NT Server is the only product we looked at that allows native file access using TCP/IP—NFS is not required. DHCP and WINS provide centralized TCP/IP address and name management on a Windows NT server, thereby relieving the network administrator from assigning TCP/IP addresses to each client. But DHCP works only with Windows NT Workstation clients.

NETWORK ADMINISTRATION

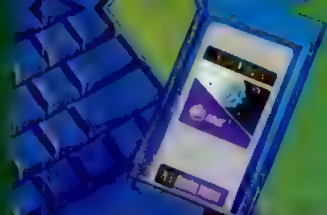
For the network administrator, Windows NT Server has one of the

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CIRCLE 233 END USERS ON READER SERVICE CARD

CIRCLE 309 RESELLERS ON READER SERVICE CARD

best interfaces we've seen. The integration of management utilities is far better than in NetWare 3.12, but we wish the utilities were even more integrated. An administrator must use the eight utilities in the Administrative Tools folder, the Network Client Administrator, the Network icon in the Control Panel, File Manager, and external log-on scripts. Also, there are no batch utilities for Windows NT Server, unlike LAN Server and NetWare 4.1. This is especially a problem when many users must be added at once.

For managing large numbers of servers, Microsoft has domain and trusted domain facilities. Basically, multiple servers can be managed together in a domain and resources can be managed across multiple domains as long as they "trust" one another. Local and global groups make cross-domain management easier. Large corporations may be better served by global naming services such as Novell's NDS because of the truly distributed nature of the directory and naming information.

Microsoft offers probably the best NetWare migration and integration tools of any of the products reviewed—including NetWare 4.1. Windows NT Server comes with NWLink, which lets you get rid of NetBIOS and just run IPX over your network. And Microsoft offers two tools that allow you to switch entirely from NetWare. The Migration Tool for NetWare migrates a NetWare 3.x server to a Windows NT Server; File and Print Services for NetWare, in beta testing at the time of this review, lets Windows NT Server run the file and print services of a NetWare server.

We simply found Windows NT Server easier to use and more powerful than NetWare 3.12. Given Microsoft's close attention to migration issues, we can even see Windows NT Server slowly making its way into diehard Net-

SUMMARY OF FEATURES

Ends



■ YES ■ NO Products listed in review order	Microsoft NT Server 3.5	NetWare 3.12	NetWare 4.1	OS/2 LAN Server 4.0 Entry	OS/2 LAN Server 4.0 Advanced	VINES 5.54
Protocol Support (cont.)						
IPX Large Internet Packet	■	■	■	■	■	■
IPX/SPX	■	■	■	■	■	■
NetBEUI	■	■	■	■	■	■
TCP/IP	■	■	■	■	■	■
Server Management						
Displays error and system status log	■	■	■	■	■	■
Displays the number of packets and bytes sent and received	■	■	■	■	■	■
Displays cache statistics	■	■	■	■	■	■
Displays cache utilization	■	■	■	■	■	■
Displays hard disk information	■	■	■	■	■	■
Displays LAN driver statistics	■	■	■	■	■	■
Displays logical-disk statistics	■	■	■	■	■	■
Displays the number of open files	■	■	■	■	■	■
Displays paging statistics	■	■	■	■	■	■
Displays the percentage of CPU utilization	■	■	■	■	■	■
Displays physical disk statistics	■	■	■	■	■	■
Displays redirector statistics	■	■	■	■	■	■
Displays server data statistics	■	■	■	■	■	■
Displays session statistics	■	■	■	■	■	■
Displays statistics of third-party server services	■	■	■	■	■	■
Can assign a single-reference time server	■	■	■	■	■	Optional
CMIP agent	■	Optional	Optional	Optional	Optional	■
NetView agent	■	■	Optional	■	■	■
SNMP agent	■	Optional	Optional	Optional	Optional	■
Audit Trails						
File and object access	■	■	■	■	■	■
Log-on and log-off	■	■	■	■	■	■
System restart and shutdown	■	■	■	■	■	■
System errors	■	■	■	■	■	■
User and group management	■	■	■	■	■	■
Fault Tolerance						
Full server redundancy (SFT III)	■	Optional	Optional	■	■	■
Duplexing	■	■	■	■	■	■
Mirroring	■	■	■	■	■	■
RAID levels supported	0, 1, 5	0, 1	0, 1	1 (others are optional)	1 (others are optional)	0, 1, 5
Client OS Support						
DOS 3.x and higher	■	■	■	■	■	■
Macintosh System 7.5	■	■	■	Optional	Optional	Optional
OS/2 1.3 and 2.x	■	■	■	■	■	■
OS/2 Warp 3	■	■	■	■	■	■
Windows 3.1	■	■	■	■	■	■
Windows for Workgroups 3.11	■	■	■	■	■	■
Windows NT Workstation 3.5	■	■	■	■	■	■
Other Services						
Backup	■	■	■	Optional	Optional	■
E-mail	■	■	■	Optional	Optional	Optional
Host connectivity	Optional	Optional	Optional	Optional	Optional	Optional
Remote access	■	Optional	Optional	Optional	Optional	Optional
Software distribution	Optional	Optional	Optional	Optional	Optional	Optional
UPS support	■	■	■	■	■	Optional (via third party)
Telephony support	Optional (via third party)	Optional	Optional	Optional (via third party)	Optional (via third party)	Optional (via third party)



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SYMANTEC.

NetWare 3.12: Functional, Not Graphical

1 To add users and groups to the network, you primarily use the SYSCON utility

2 With the template, you can add users who have common default settings

3 You also can create a template for users with the USERDEF utility

Ware shops. But only time will tell whether companies will decide to replace their old friend with a new friend.

Microsoft Windows NT Server 3.5. *Microsoft Corp., One Microsoft Way, Redmond, WA 98052-6399; 800-426-9400, 206-882-8080; fax, 206-883-8101.*

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Novell Inc.

NetWare 3.12

BY DIANE DANIELLE

The most popular network operating system in the world, NetWare 3.12 far outsells its competition—but that may soon change. Though you can still get superb file performance, acceptable management, and a wide array of third-party products, NetWare 3.12 lacks the niceties of newer network operating systems: domain or directory services, a viable application platform, hardware auto-detection, a unified management interface, intuitive installation, and easy printing. But despite NetWare 3.12's shortcomings, it may be difficult for other products to displace this popular one anytime soon.

Novell wants NetWare to be your network glue and offers options for every scenario—Unix and SNA connectivity, routing over leased and dial-up lines, telephony, video, messaging, e-mail (MHS, GroupWise), and network management (NMS, LANalyzer, and Hub Services).

These options blend together in NetWare's attempt to serve as the corporate

backbone. But its positioning has not been perfect. Management of multiple servers remains difficult, and NetWare 3.12 does not support NDS, which means that mixing 3.12 and 4.1 servers is problematic. And though many basic NLMs are available for NetWare, Novell has failed to provide a stable application-server development environment for critical databases. To address the application-server market, Novell sells UnixWare and talks about its planned SuperNOS, which will combine the best of NetWare and Unix. The strategy has been successful primarily in generating confusion and concern on the part of even Novell's most devoted customers.

INSTALLATION

When NetWare 3.0 shipped in 1988, the network operating system seemed a marvel of simplicity. But NetWare 3.12 is now one of the most difficult NOSs to install, so keep the manual handy. You can also get assistance from a quick-start guide, which we recommend reading.

All versions of NetWare, unlike the other NOSs here, require start-up help from DOS. You need a bootable DOS system, a CD-ROM device driver, and MSCDEX to access the installation CD-ROM. Then you must hunt for the installation program, located in the NETWARE.312\ENGLISH directory. Sometimes you will find yourself at a command line prompt without any idea what to do next. Although NetWare 3.12 supports a wide range of NIC and hard disk drivers, it has

SUITABILITY TO TASK

NetWare 3.12

Installation	Fair
Administration	Fair
Directory services	Poor
Integration	Good

no auto-detection (like that of Microsoft Windows NT or OS/2 LAN Server). You must know what your hardware is and how it's been installed.

Once you've installed the server, you'll have to search on the installation CD for utilities to create client installation disks for DOS, Windows, and OS/2. Installing the Macintosh server software is a potentially complex manual process. You can use Windows NT's own client to attach to a NetWare server, but at the time of this review, Novell did not offer a Windows NT requester. OS/2 and Macintosh file systems are supported out of the box, but support for NFS is sold separately. Server-based TCP/IP support comes with NetWare; the client component is optional.

ADMINISTRATION

Many people have problems with the plethora of mostly DOS-based management utilities for NetWare 3.12. More important, some of the utilities—particularly the printing utilities—are poorly designed. To take advantage of even the better ones requires a knowledge of some hidden tricks. On the plus side, especially for managers who use and support DOS, the inclusion of command line utilities as well as menu-based utilities offers welcome flexibility.

NetWare 3.12 contains the by-now common set of administrative capabilities. Managers can set default conditions (such as length and uniqueness of passwords) for users, create individual login scripts in place of—or in addition to—a global script for all users, and assign access privileges to files and directories based on individual user IDs or group membership. Two DOS utilities, MAP ROOT (which makes a subdirectory look like a root directory) and SMODE (which lets you alter an executable's default search path), are key tools for network managers supporting Windows and other network-hostile apps. The server utilities provide basic information but give you no way to track historical performance.

The process for mirroring or duplexing is simple unless you add a lot of spanned volumes with segments on different drives. With the appropriate hardware, however, you can actually add disk space to an existing volume

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without taking down either the server or the volume—although we would not recommend doing this.

Printing, more than any other service, is NetWare 3.12's Achilles' heel. The print services work fine and include many options, but they're clumsy to con-

figure. The process for creating print queues and servers and print configuration jobs—a real boon when dealing with older DOS applications and many vertical applications—is difficult to work with. Nevertheless, we had no trouble printing from any of our clients under

any of the configurations.

Most NetWare managers do their best to hide the network from their users. NetWare does, however, offer utilities such as NWUSER for Windows and SESSION for DOS to connect to servers, FILER for doing file and directory man-

▪ Why App Servers Are Hot

By Jeffrey G. Witt

Application servers are a key part of the network's evolution beyond standard file and print functions. An application-server system consists of a requesting machine—a *network client*—and a providing machine—the *server*.

This relationship goes further than the transfer of files from a shared hard disk, typical of today's networks. The client provides the user interface and executes part of the processing. The server processes requests from the client and provides the information. In this way, disk-intensive functions such as indexing and sorting files take place close to the file-storage system and the files are preserved in a protected server. The server OS must provide performance, scalability, and reliability.

Most people think of client/server in terms of migrating from minicomputer or mainframe platforms. Though this model is an important part of the application-server concept, the birth of new applications and the *upsizing* of existing software is just as important.

Moving a mission-critical application from a mainframe or minicomputer environment can be cost-effective, because it reduces the number of support personnel, software upgrades, and maintenance fees. Often the migration leaves the existing big iron systems in place, as long as they meet business needs. But not many new applications are being developed for mainframe systems. Frequently, existing PC-based applications are stretched beyond the point where faster hardware helps. They need a rewrite in the client/server model.

WHY NETWARE 3.X DOESN'T CUT IT

NetWare 3.x was designed to exploit the Intel 386 architecture for superior performance as a *file and print server*. Its design includes *NetWare Loadable Modules* (NLMs)—programs that run on the server—to integrate server-based applications smoothly.

Good NLMs aren't easy to write, however. Intel's x86 processor architecture allows operating systems to function at a layer called *ring 0*, which has the most privileges in terms of access to system functions. Most applications operate in *ring 3* using protected mode to ensure system reliability. NetWare NLMs are required to run in ring 0, which offers high performance but low reliability. Furthermore, NetWare 3.x lacks *preemptive multitasking*, without which an application's task can often dominate processing at the expense of other applications or the OS.

MULTIPROCESSOR NETWARE

Under NetWare 4.1, an application can run in a protected area where its failure won't crash the server. But NetWare 4.1 can't talk to more than one processor at a time. Though Novell plans to release multiprocessor support by midyear, NLMs will need to be rewritten to take full advantage of multiprocessing. Novell's other current application server, UnixWare 2.0, offers multiprocessing, multithreading, and backward compatibility with SCO Unix applications.

KEY INGREDIENTS

Network administrators are looking for server operating systems that can func-

tion in an environment where multiple servers perform client requests. When examining NOSs, you should consider these key ingredients:

- *Multitasking* performs the management and distribution of concurrent or multiple tasks across server resources. The system must be able to process and distribute the load.
- *Multithreading* allows interrelated tasks to work with less overhead than several different programs would require. A *thread* is a set of instructions that make up an application. Multithreaded applications execute multiple instructions independently.
- *Scalability* refers to the ability of the operating system to distribute the workload effectively across the system's multiple processors or resources.
- *Preemptive scheduling* allows a task to be interrupted by higher-priority tasks so that another process receives faster service from the server.
- *Advanced memory management* functions support the loading of large programs into memory and handle memory paging without corruption.
- The server's *file system* must support concurrent disk access by several tasks while maintaining record preservation (file and record locking), and it must sustain a large number of open files without affecting I/O requests.

WHICH PLATFORM, WHICH NOS?

Any number of hardware platforms can provide the horsepower for an application server: x86 PCs, RISC servers, or minicomputers. To compare performance of application services in the x86 environment, PC Magazine Labs ran ServerBench, Version 2.0, with one,

agement (a truly unpreprocessing product), and PCONSOLE for checking printer queues. Macintosh users also have access to user and printer management tools.

Lastly, it must be said that NetWare 3.12 is the only major NOS today in which

security is single-server based. Most of the utilities make it relatively easy to switch among servers, and a variety of techniques exist for hiding the complexities of a multiple-server environment from the average user. People have become accustomed to using NetWare 3.12. But compared with

today's NOSs, NetWare 3.12 is hard to justify for multiple-server environments.

Novell clearly is positioning NetWare 4.1, with its global directory services, as the logical successor to 3.12. Nevertheless, the company felt it worthwhile to ship this version of NetWare. Though it's a modest

two, three, and four Intel processors on Microsoft Windows NT Server 3.5, OS/2 2.11 for SMP, and SCO Open Server Enterprise System 3.0 with MPX. (See our benchmark tests of multiprocessor NOSs.)

SCO OPEN SERVER: POPULAR APP SERVER

The Santa Cruz Operation's flavor of Unix has long offered a platform with many of the features required for application servers. Under Server-Bench, SCO Open Server had the best throughput with one processor, but it couldn't match OS/2 and Windows NT Server at two or more processors. We attribute this to the operating system's lack of complete multithreading. Specifically, SCO Open Server's Streams (an architecture for communication between programs and device drivers) and TCP/IP software are single-threaded. This puts an extra load on one of the processors and increases the number of interprocessor interrupts.

SCO Open Server's lack of scaling performance may only be temporary. The company plans to ship a revamped version later this year, code-named Everest, with true multithreading and built-in SMP support.

OS/2 2.11 FOR SMP

IBM's OS/2 2.11 for SMP offers an Intel processor-specific platform for running network applications. OS/2 2.11 for SMP outperforms SCO Open Server in systems with 3 or 4 processors but is still compatible with existing DOS and Windows applications. Users whose machines have only one CPU will want to stick with the non-SMP version of OS/2, which was about 10 percent faster than the SMP version.

Despite its add-on approach, OS/2 consistently scaled better than SCO Open Server, maintaining the same performance level over increasing client loads. Even with its linear scalability, though, we didn't see the high transaction rate that we saw with Windows NT

Server. Although OS/2 is multithreaded, it does not offer full preemptive scheduling. The thread is unalterably assigned once it leaves the OS kernel. OS/2's inability to prioritize and redistribute threads can lead to some CPU imbalance.

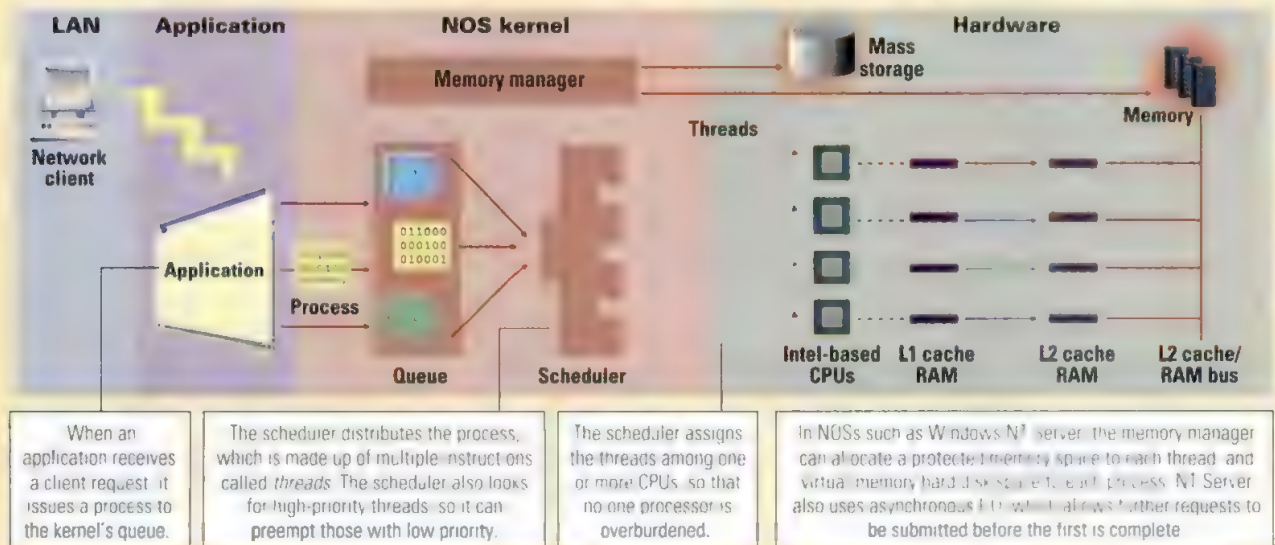
WINDOWS NT: SPEED CHAMP

Windows NT Server 3.5 is the newest of these server OSs, and Microsoft was able to create it from the ground up to incorporate multiprocessing and other advanced OS features. The result: far better scaling than we saw with OS/2 and SCO Open Server.

Windows NT Server's unique architecture allows for true multithreading and preemptive scheduling. The kernel uses an asynchronous system I/O approach that performs multiple tasks at the same time. Additional memory is made available to applications by the kernel's virtual memory manager so that an application gets more RAM when it needs it. □

The Complex Art of Multiprocessing

To kick performance-intensive application servers into overdrive, a multiprocessing NOS is essential. Here's how the software does the work.



Benchmark Tests: Multiprocessor NOSs

Of the NOSs tested, Windows NT Server had the best scalability and multiprocessor performance.

What the Numbers Mean

For file and print services, benchmark testing shows little real-world difference among network operating systems. But client/server capabilities are different. Using ServerBench 2.0, PC Magazine Labs tested Microsoft Windows NT Server 3.5, OS/2 2.11 for SMP, and SCO Open Server Enterprise System 3.0 with MPX. (ServerBench is not currently available for NetWare 4.1 and VINES.) For comparison, we tested NetWare 3.12 (a single-processor NOS) and nonmultiprocessing versions of OS/2 2.11 and SCO Open Server.

Our benchmark scores give SCO Open Server the highest one-processor rating. But beyond two processors, it could not keep up with OS/2 and Windows NT Server. Windows NT Server emerged as the top performer overall.

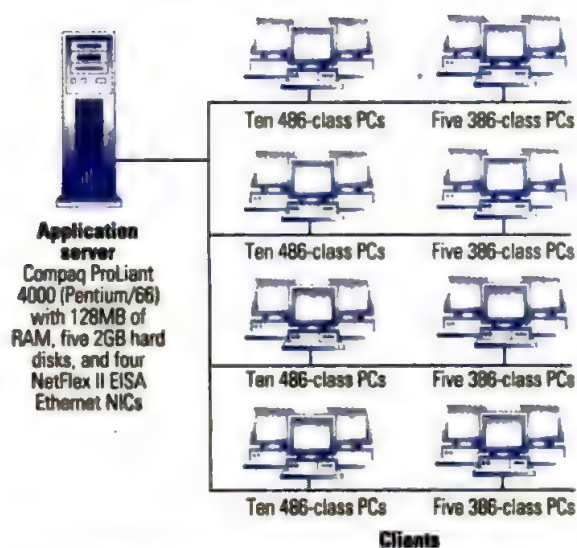
—Analysis by Jeffrey G. Witt

How We Tested

ServerBench, Version 2.0, simulates a client/server database and measures the rate at which the server processes client requests. Using ServerBench, we submitted workloads starting with 1 client and raising the load in 4-client increments until we reached 60. The resulting scores are the transactions per second (TPS) that the server could process for each number of clients. (Higher scores represent better performance.)

The test-bed file server was a Compaq ProLiant 4000 configured with one 66-MHz Pentium CPU, 128MB of

Test-Bed Configuration

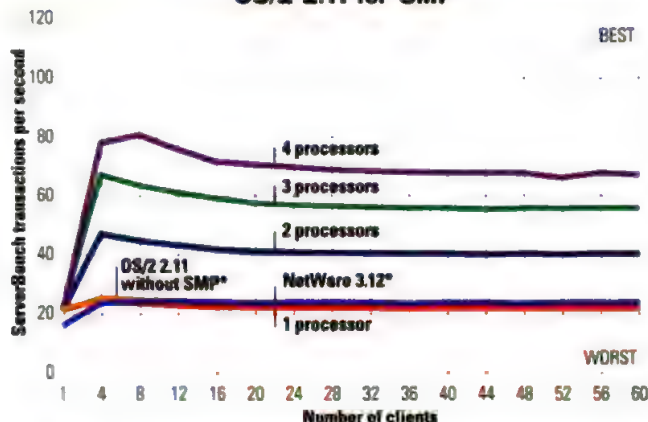


We configured each client with Microsoft Windows for Workgroups 3.11 and 8MB of RAM.

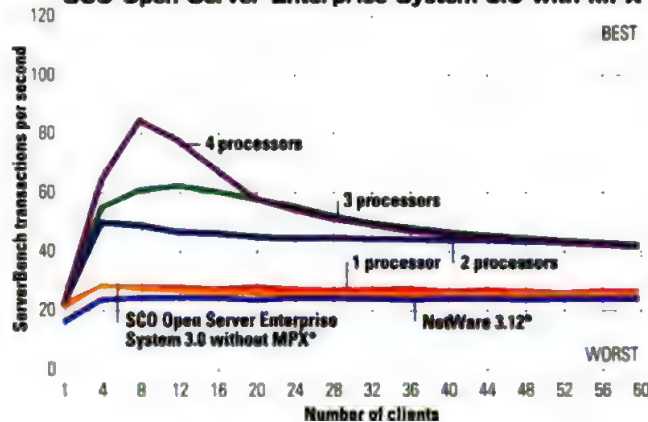
RAM, four Compaq NetFlex II EISA Ethernet NICs, five 2GB hard disks, and a Compaq SCSI Smart Array controller. After we installed each NOS on the first hard disk with the vendor's recommended tuning parameters, we striped that data across the four additional hard disks. To measure system scaling, we incrementally added three 66-MHz Pentium CPUs. Our 60-node test-bed consisted of four Ethernet segments. Each segment had 15 workstations running Microsoft Windows for Workgroups 3.11; the workstations ranged from 386SX- to 486DX/33-based PCs, each with 8MB of RAM.

SERVERBENCH 2.0

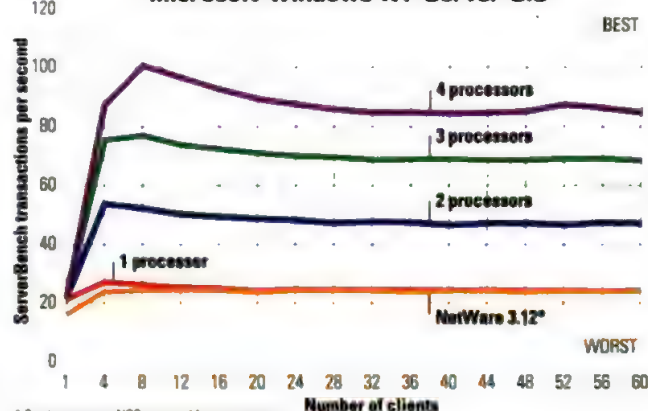
OS/2 2.11 for SMP



SCO Open Server Enterprise System 3.0 with MPX



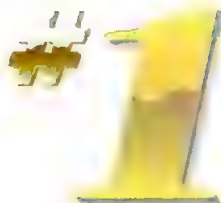
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* Single-processor NOS, reported for comparison

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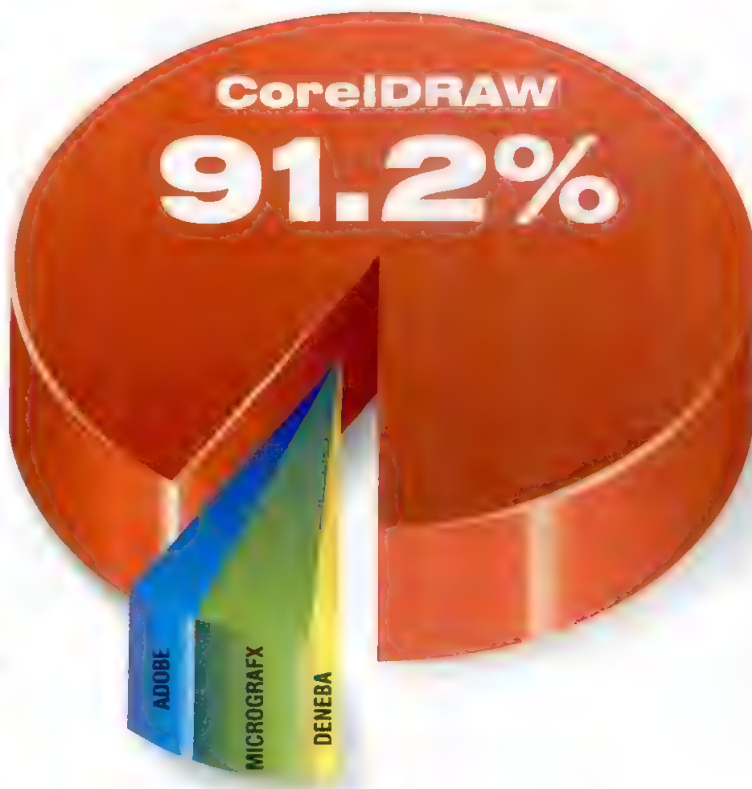
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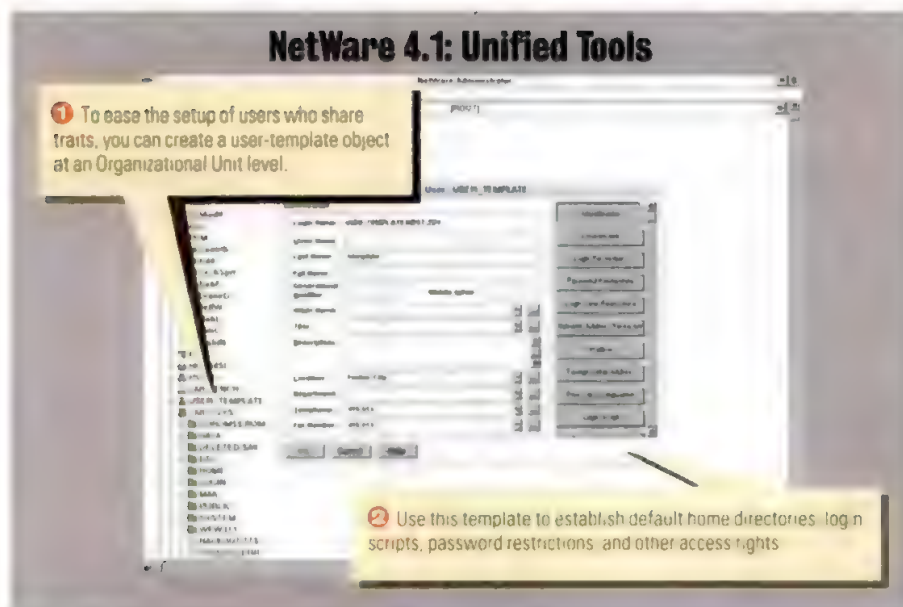
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improvement on the previous version, NetWare 3.12 could have included more ease-of-use features, such as a status line with help in the utilities or an NLM for installation. It's solid and reliable but is showing its age.

NetWare 3.12. Novell Inc., 122 East 1700 South, Provo, UT 84606; 800-638-9273, 801-429-7000; fax, 801-429-5200.

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Novell Inc.

NetWare 4.1

BY DIANE DANIELLE



If you had to build a network from the ground up today, you wouldn't go wrong choosing NetWare 4.1 for the job. But most network managers have a network in place already—and Novell wants to convince them that NetWare 4.1 is the next logical step. This NOS includes directory services with a graphical management tool, disk management enhancements that will save space, a new link-services protocol for WANs, and a vastly improved installation program, all of which make it suitable for any size network. Still, Novell must convince its customers that NetWare is the right platform for critical database applications.

For old NetWare hands, NetWare 4.1 contains much that is comforting and familiar (NLMs, server configuration files, login

scripts, the MAP command) as well as much that is new or scary (file compression and migration, directory services). Most of these features were in NetWare 4.0, but that dread point-zero version lacked some key features in its NDS implementation and third-party support. Not only were managers faced with a new way of organizing resources, but the tool for managing them, NWADMIN, was deficient. You could design an administrative structure that was too large for NWADMIN to display. Worse, it was difficult, sometimes impossible, to make changes in the directory services structure.

Novell originally billed NetWare 4.x as an enterprise NOS, but it has included features such as simple installation that also will appeal to workgroup networks. NetWare 4.1 solves the problems of the 4.0 release, and Novell hopes these changes will finally convince NetWare shops that 4.1 is a natural and desirable migration path.

INSTALLATION

The difference between the NetWare you know and love and 4.1 begins with installation. Although you still need DOS with support for an attached CD-ROM drive, the INSTALL.BAT in 4.1 leads you through the installation of the basic operating system and optional features. NetWare 3.12 gurus won't realize until they see the install procedure just how much typing they have had to do. You can choose from three

options: simple, custom, or upgrade. The product also ships with a separate migration tool to transfer earlier versions of NetWare from an existing server to a new server, so you don't have to upgrade in place.

To complete the simple installation, you must select your network driver and hard disk driver—NetWare 4.1 does not have the auto-detection capabilities of OS/2 LAN Server or Microsoft Windows NT Server—and the installation program pretty much does the rest. Use the custom option to span volumes, do mirroring or duplexing, or other advanced features. If you're upgrading a NetWare 3.x server, you even have the chance to do a side-by-side comparison of the old and new AUTOEXEC.NCFs and modify them.

After the basic operating system has been installed, an enhanced INSTALL.NLM pops up to let you make changes or add new features, including Macintosh file and print services and TCP/IP. Using client-creation utilities, you can create DOS, Windows, or OS/2 disks, which let you upgrade older client drivers.

ADMINISTRATION

The care and feeding of NetWare is also easier and more powerful. This latest version includes a console utility called INETCFG that lets you centralize the management of all the protocols you want to

support on the server. You can also install NetWare Link Services Protocol (NLSP)—Novell's new router protocol that gives you better WAN performance by freeing up bandwidth. Besides several new

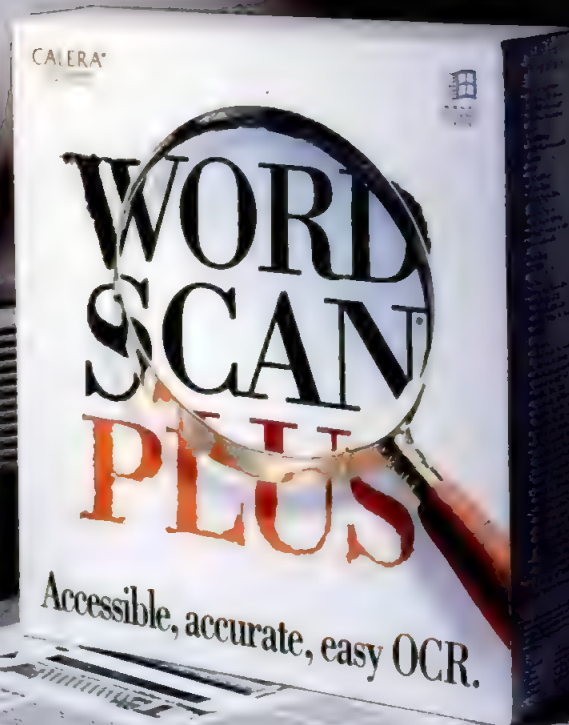
console management utilities, NetWare 4.1 includes enhanced 3.x utilities. For instance, SERVMAN lets you see and configure virtually every possible parameter. As with NetWare 3.12, these utilities are not graphical, but it is easy to load them automatically and switch among them.

The tool most managers will be spending time with is NWADMIN, the new Windows-based network administration tool. If you like a graphical interface and you want a single management utility, this is it. It is not perfect—NetWare-knowledgeable Windows programmers take note—but no other NOS has a better interface.

You can't talk about NWADMIN without talking about the NetWare Di-

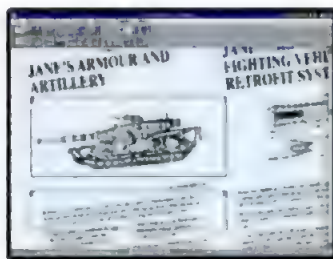
SUITABILITY TO TASK	
NetWare 4.1	
Installation	Good
Administration	Excellent
Directory services	Excellent
Integration	Good

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rectory Services (NDS). Of the differences between NetWare 3.x and NetWare 4.1, this is the one that matters if you want easier network administration. NDS is an X.500-like, global, distributed directory service. More than that, it is extensible: Third-party developers can add hooks to NDS. Novell has made it possible to build a simple, flat directory tree quickly and easily. But NDS is not simple. Creating an optimal directory structure for a large, worldwide network will require extensive planning and practice; however, the tools for making changes have been significantly improved over those in NetWare 4.0.

Our biggest complaint about NDS is that the "simple" single log-on to the network isn't as simple as you'd expect. Because context—a user's position in the directory-services tree—is everything under NDS, just typing your user ID may get you nowhere. The approved way to set a context is to put it in the workstation's network-configuration file. But this is not a good alternative to typing a name, because users may want to log on from workstations that have different contexts.

NDS is more than just a multiserver version of NetWare's old server-based security; it has additional management and security capabilities. Permissions can be granted not only to objects such as files, directories, and printers, but also to the attributes of those objects. NDS includes a variety of aliasing capabilities, such as giving a location-independent name to a directory. A secure auditor function has been added, as well as some primitive printing accounting.

If only Novell had done something more with printing—setting up printing is still awkward. But NetWare 4.1 includes several wonderful file enhancements: optional file compression, block suballocation (so your 500-byte files don't consume 4K of disk space), and a migration attribute to support hierarchical storage management systems.

Although we expect to see even more enhancements, NetWare 4.1 has what the market has been demanding for years: a directory service to rival Banyan's StreetTalk, a graphical administration utility to rival OS/2 LAN Server's and Windows NT Server's, and NetWare's performance and reliability. If you have a

small NetWare network, we encourage you to take a look at 4.1. If you're a NetWare shop with a lot of servers, you should strongly consider a move to NetWare 4.1.

NetWare 4.1. Novell Inc., 122 East 1700 South, Provo, UT 84606; 800-638-9273, 801-429-7000; fax, 801-429-5200.

Circle 517 on reader service card

IBM Corp.

OS/2 LAN Server 4.0 Entry OS/2 LAN Server 4.0 Advanced

BY ROBERT D. FRANK

IBM's updated industrial-strength NOS is finally moving out of the dark ages of command line processing and into the world of slick, easy-to-use graphical front ends. OS/2 LAN Server 4.0 is the first version that uses the OS/2 Workplace shell to make ease of use the byword for setup, administration, and configuration of the LAN. Installation and setup have been greatly improved, with auto-detection for network adapters and support for more client operating systems—including Microsoft Windows for Workgroups and Windows NT.

LAN Server comes in two versions: Entry and Advanced. Entry is aimed at workgroups of fewer than 100 users. The Advanced version targets larger groups of

up to 1,000 users and offers advanced disk performance with the HPFS file system. (All comments in this review pertain to both Entry and Advanced unless otherwise noted.) Both versions run on OS/2 and use the

32-bit preemptive multitasking, multithreading operating system to ensure a high level of reliability. With full OS/2 symmetric multiprocessing (SMP), it becomes obvious that IBM is delivering not just a stalwart contender in the file-and-print services arena, but also an application server.

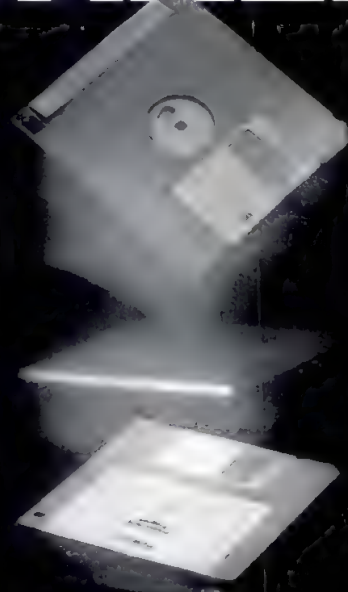
Both products are part of IBM's evolving network strategy. With LAN Server 4.0's new look and ease of use, IBM is making its strongest bid yet for the classic NetWare market. Moreover, IBM is eager to prove how easy it is to migrate from NetWare. Still, LAN Server's lack of

SUITABILITY TO TASK

OS/2 LAN Server 4.0

Installation	Excellent
Administration	Good
Directory services	Good
Integration	Fair

HEADS, IT'S REAL. TAILS, IT'S FAKE.



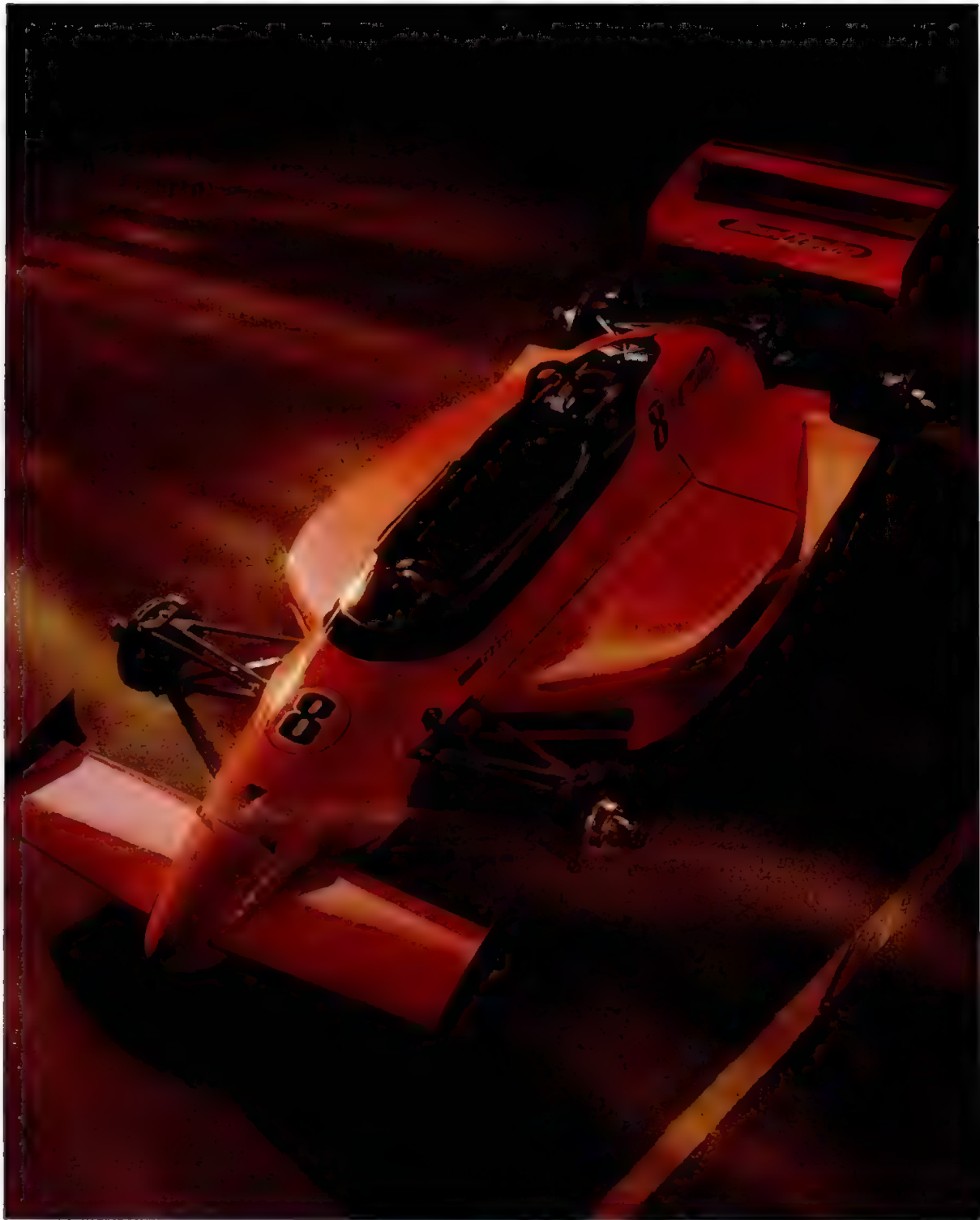
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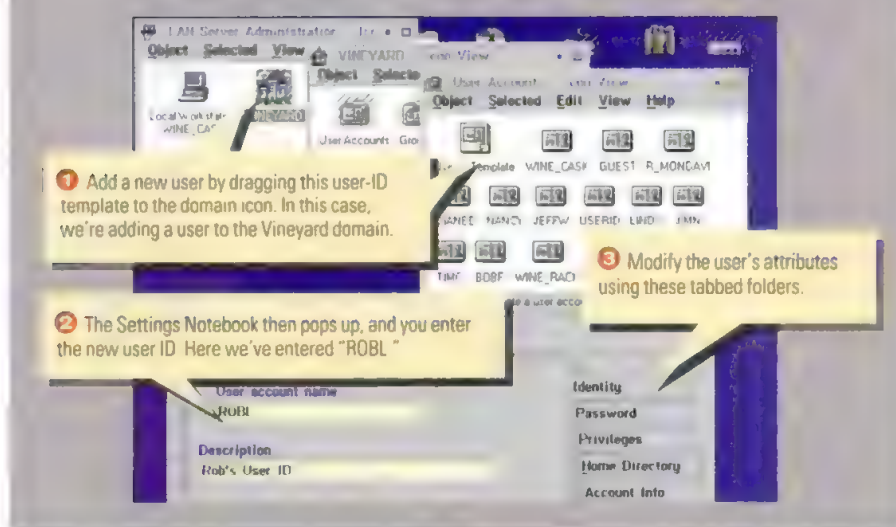
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OS/2 LAN Server 4.0: Drag-and-Drop Setup



IPX support will probably prevent any mass change. Each client must run NetBEUI or TCP/IP; IBM will need to take a page out of Microsoft's book and offer IPX to attract NetWare users. And Big Blue hasn't strayed completely from its big iron. IBM offers LAN Server for AIX, AS/400, and VM and MVS systems on ES/9000 mainframes.

IBM also offers a cadre of products that address more applications than Microsoft BackOffice. The LAN Server family of products includes Communications Manager/2, which is equivalent to Microsoft's SNA Server; DB/2 with DDCS, a SQL database; the soon-to-be-released Workgroup Server that addresses mail from both PROFS and AS/400 OfficeVision; and NetView OS/2 for network management. Also, IBM is addressing Novell's NDS with its plans to implement security with the Open Systems Interface (OSI) Distributed Computing Environment (DCE).

ADMINISTRATION

Unlike its predecessors, LAN Server 4.0 sports a modern, graphical interface that meets the expectations of the Windows generation of users. The LAN Server Administration tool consists of a series of folders with predefined task templates that pop up after the user clicks on the domain. Administrators access User Accounts for adding new users; Groups for defining groups of users; Defined Servers to display all servers known to the domain; Resource Definitions to define

printers, serial devices, and directories; and Public Applications to define shared applications across the network.

INSTALLATION

Installing from CD-ROM was almost a cinch. We got LAN Server up and running in 9 minutes (not including installation of OS/2, which took 20 minutes). The system asked us just four questions: what to name the server; what to name the domain; whether this was the first server on the domain; and whether the adapter type discovered by the system was correct.

This last step was the one quirk we uncovered: The popular Eagle NE3200 was not among the almost 150 adapters for which LAN Server provides a driver. So although LAN Server discovered the two Eagle NE3200 adapters installed in our server, it couldn't install a driver. Even when we provided LAN Server with the proper driver, we couldn't get it to work. We replaced the adapters with 3Com EtherLink III's, and the installation then went flawlessly. IBM currently is developing an NE3200 driver for LAN Server.

This new version of LAN Server supports more clients than before, and its peer-to-peer services are also improved. Installation of OS/2 Warp, Microsoft Windows for Workgroups, DOS, and Macintosh clients went very smoothly. The new DOS LAN Requester has an easy-to-use GUI that looks and acts like Windows' File Manager and Print Manager. The Macintosh client option runs on

the server, making it look like a Macintosh server.

Windows for Workgroups clients can operate natively without DOS LAN Requester. You can access files and printers, but without the requester you won't get what IBM calls a single-image view of all the resources and services of the LAN Server domain—including all applications and aliases. The single-image view is helpful enough to warrant spending the \$50-per-client list price.

Although IBM says Windows NT Workstation is supported natively, the documentation does not describe how to install it. When we tried to browse the paths available to the client, we came up empty-handed even though we entered the domain name in the appropriate field on the client. IBM directed us to put our domain name into the Windows NT file called "Workgroup." It worked, but just for files and directories. We were never able to get Print Manager to function properly.

The most impressive change in LAN Server since Version 3.0 is the new user interface, which gives the average administrator a much easier method of performing tasks. Other new features include extensive documentation, in the form of easy-to-use manuals and 11 indexed on-line documents. There are new applets and task folders that reduce the administrator workload. And IBM offers a free, comprehensive workbook, "Migrating to OS/2 LAN Server from NetWare," which includes step-by-step instructions and a migration tool for NetWare 2.x and 3.x users.

For small companies or departmental systems, the simplicity of LAN Server Entry and its ability to run in a nondedicated environment provide an inexpensive network solution that allows for easy sharing of printers, files, and other devices and resources. In larger enterprises, LAN Server 4.0 Advanced provides the ability to connect 1,000 users concurrently. This product is an excellent fit for small businesses considering adding a network to their environment, and it may be an excellent choice for large enterprises that are ready for a change from NetWare.

OS/2 LAN Server 4.0 Entry, OS/2 LAN Server Advanced. IBM Corp., 11400 Burnet Rd., Austin, TX 78758; 800-426-2255; fax, 800-426-4329.

Circle 518 on reader service card

▪ Advanced Network Services

By Garry Frenkel

Imagine if selling a product meant publishing a proprietary version of a public phone book. Sound crazy? Software vendors have done just that for years: Each mail application or workflow package requires its own white pages, called a directory.

Network managers have the laborious task of creating, maintaining, and synchronizing directories for each network service. That complexity makes it difficult for vendors to create popular networked apps.

Enter global directories. When implemented properly, they enable applications ranging from imaging to telephony to groupware. A rich global directory allows you to define all network objects—users, servers, printers, and gateways—at one time, in one place, for your entire enterprise. Banyan's StreetTalk and Novell's NetWare Directory Services (NDS, on NetWare 4.x only) are examples of global directory services; Microsoft Windows NT Server and OS/2 LAN Server have domain-based directory services.

Though all the vendors in this article offer directory services (except NetWare 3.12), significant architectural differences exist. A global directory service views the entire network as a single entity. A domain directory consists of one or more linked servers; using one effectively takes careful planning.

BANYAN VS. NOVELL

For years, Banyan's StreetTalk set the standard for a LAN-based global directory. Taking advantage of a glob-

ally distributed, partially replicated database, StreetTalk uses a hierarchical three-part naming structure that efficiently and logically defines network objects in a format that is easy to use and remember.

NetWare Directory Services also replicates the directory database and distributes it across the network, providing duplicate copies in the case of an unavailable server. NDS offers a hierarchy that can be 15 levels deep, allowing you to mirror your actual organizational structure. NDS's naming structure, closely modeled after the X.500 spec, offers greater flexibility but can lead to overly complex, unintuitive names.

Although the NDS design is more robust and offers greater flexibility, StreetTalk stands out for the proven value of its directory assistance tools. These let administrators prune and graft branches of the corporate directory structure as users and departments change. The lack of these tools was seen as the primary impediment to the initial acceptance of NetWare 4.x. With NetWare 4.1, Novell has greatly alleviated this problem.

DOMAIN SERVICES

Windows NT Server and OS/2 LAN Server use domain-based directory services. These allow managers to group users and resources together logically into a domain controlled by a server called a primary domain controller (PDC). Users log on to the PDC, which validates the account and provides access to the appropri-

ate services across the domain. But each domain in an enterprise still must be maintained and administered individually.

Microsoft has improved on the domain model by adding a service called Interdomain Trust (IT). With IT, the primary domain controller in your home domain communicates with PDCs in other domains and vouches for you and your requests. Although user accounts do not have to be replicated across domains, administrators still spend time assigning remote-access privileges for each resource.

IBM's OS/2 LAN Server provides a form of interdomain access by allowing access to resources in other domains via a single-domain log-on. It still requires an account, however, as well as specific access privileges to any of the resources in that domain.

THE DREAM OF INTEGRATION

The dream of every network administrator is for all services to share a single, common, globally administered directory. In the short term, the only way to realize this will be to use the additional network services provided by NOS vendors. In the long term, the X.500 directory services specification will come to the rescue.

Novell's NDS is based on X.500 with proprietary extensions. Banyan, IBM, and Microsoft have also announced X.500 plans. When fully X.500-compliant directory services become available, application vendors can develop products that use interchangeable directory services. □

Banyan Systems Inc.

VINES 5.54

BY VISHY NARAYAN

Historically, Banyan's VINES had been the strongest tool for managing global resources on a large network with multiple servers and WAN links. In the workgroup, however, VINES has

been overshadowed by NetWare's better performance and broad support. Now, with its primary niche being threatened by NetWare 4.1's directory services and scalability, Banyan has to fight even harder to retain a competitive edge for VINES.

The company recently announced plans for Version 6.0 of VINES—which would be the first major revision of the

product in two years—but no further information about the revision was available from the company at press time. VINES contains multiprocessing capabilities and its underlying Unix operating system offers an application-server platform, although it is probably only attractive to existing Banyan network installations.

The VINES (Virtual Network System)

Network Operating Systems

network operating system consists of a strong set of Enterprise Network Services (ENS), which include network management, network security, and the much-acclaimed StreetTalk III—a global directory service that makes identifying and changing users and network resources throughout the enterprise simple and convenient. Specific versions of ENS for NetWare, SCO Unix, and HP-UX are available so that servers running those operating systems can interoperate and even share management in a network running VINES servers.

Banyan's network services integrate various clients, software, and network devices across LAN and WAN connections into one unified system. Applications and host connections become readily available to every network user from any location. Its intelligent message-handling system works well with a range of network topologies and supports numerous types of wide area links. You have to keep track of all server keys and keys for any extra options installed. Organizations can link PC resources into a fully distributed network across departments and geographically separated environments. Banyan's VINES network operating system provides the right mix to build a network with a robust set of network services.

INSTALLATION

Installing VINES was easy but time-consuming—it took considerably longer than any other NOS in this review. You must manually load the server adapter's drivers, and you must know its slot number and interrupt vector; unlike Microsoft Windows NT Server or OS/2 LAN Server, VINES has no auto-detect feature. The VINES server-installation system does include a host of drivers for LAN adapters. The server can also route among as many as four LAN or WAN adapters.

When you install the first server, you need to give it a three-part StreetTalk name in the form of "server@group@organization" and an administrator name. Banyan's directory services tracks all servers on the network, and only an administrator can add a new server. After a reboot, the server starts all the file, print, communications, and other administra-

tive services.

For software licensing purposes, Banyan ties all software and options to a hardware key that attaches to the server's printer port. Administrators of large networks will find this cumbersome; as the servers (and the options installed on them) multiply, so do the number of hardware keys that attach to each other. Banyan says that this feature may be removed in a future release, but for the time being it's an irritant.

Banyan's DOS and Windows NT client software installs smoothly. Banyan currently provides OS/2 2.x client software and plans to release OS/2 Warp client software. Installing AppleTalk for Macintosh clients is straightforward, but you need to configure routing at the server.

ADMINISTRATION

Almost all of VINES's administrative tools use Banyan's Manage application. You use this program's DOS-based menus to set up user profiles, access rights, groups, security attributes for users and groups, and file and print services. Users, servers, printers, and any other network device or resource have a three-part StreetTalk address: device (or user) name, group name, and organization name. For example, the address of the printer we used in our tests was "Printer@Testbed@ZDLABS," where Printer was the device name, Testbed was a group, and

ZDLABS was the organization name. VINES users can use any resource on the network, even though they can belong to only one organization group.

Administering a VINES network is fairly painless, and we found the text-based menus clearly arranged and intuitive. VINES resources are service-based rather than server-based. Users log on once and gain instant access to any device on the network for which they have access rights. Each StreetTalk service maintains a distributed database of the resources and usage across the network.

VINES offers user-by-user access control for every network directory, device, and resource—everything from user log-on to data protection with passwords encrypted with a proprietary scheme. Security can be centralized or delegated to local workgroups.

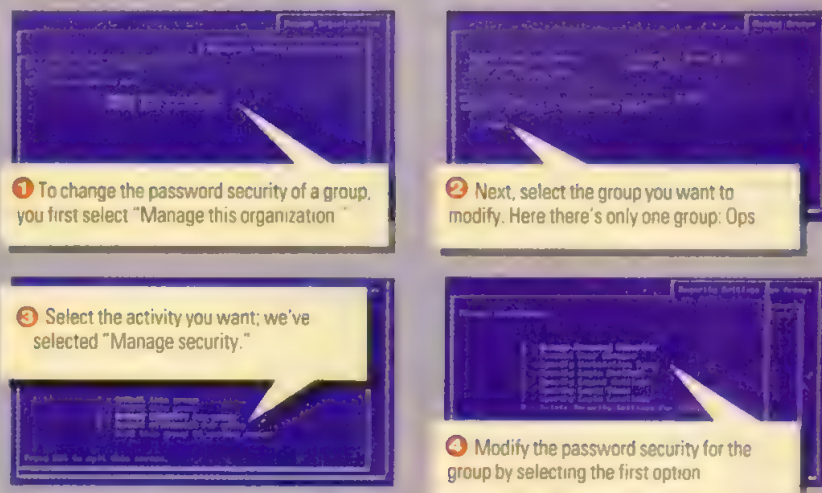
With its directory services, reliable operation, and robust mail option, VINES is a front-runner in enterprise network operating systems. The management software needs a graphical user interface, and the package needs a faster and better-automated installation process. Without these few rough edges, and given its impressive global directory and scalable network services, VINES could stand up to any NOS in the market. □

VINES 5.54. Banyan Systems Inc., 120 Flanders Rd., Westboro, MA 01581; 800-828-2404, 508-898-1000; fax, 508-898-1755.

Circle 519 on reader service card

SUITABILITY TO TASK	
VINES 5.54	
Installation	Fair
Administration	Fair
Directory services	Excellent
Integration	Fair

VINES 5.54: One Screen at a Time



User-to-User

BY NEIL J. RUBENKING

Trigger Another PC On Your Network

My PC is set up to create several files automatically. These files then need to be copied to another PC on our network, where they will be sent out by modem. To maintain the integrity of the set, I don't want to send out any files until all of them are ready. Thus, I need to put the second PC in "wait mode" until it receives all the files. To create this "wait mode," I run the following batch program on the second PC:

```
:wait
if exist F:\TRIGGER then goto start
goto wait
:start
del F:\TRIGGER
REM Start communication process here
```

F: is a network drive accessible from both PCs. When the first PC has finished creating all the files, I simply copy any file into the F:\ directory and name it TRIGGER. The second PC detects the existence of the TRIGGER file in F:\, resets the trigger message by deleting the TRIGGER file, and starts the communication process.

You can extend this example to activate different PCs on your network by naming the trigger files differently for each PC (for example, TRIGGER.PC1,

TRIGGER.PC2, and so forth). If you need to coordinate programs that are run on different PCs on a network, this simple technique can help.

*Ken Lui
Orinda, California*

► **PC MAGAZINE:** The trigger file acts as a very simple network semaphore. Network programmers have much more sophisticated techniques available for synchronizing work on different stations, but for a simple situation like the one described above, a semaphore file will work just fine.

Copying a file to F:\TRIGGER may be overkill, though. At the very least, make sure it's a small file! In a strictly DOS-based system, I'd suggest creating a zero-byte file by redirecting the output of the REM command. It's conceivable, however, that your network operating system might not support this technique. Before relying on this method, try this simple test. At the DOS prompt, enter these two commands:

```
REM > F:\TRIGGER
DIR F:\TRIGGER
```

If the zero-byte TRIGGER file appears in the directory listing, you can use the REM > F:\TRIGGER command instead of copying a file to the network drive. Of course, you'll replace F: with the drive

letter of your shared network server in both cases. That way it uses up no space on your server.

More Flexible Help in EDIT.COM

I appreciated the suggestion for making DOS HELP.HLP available in the DOS Editor (December 20, 1994), but there's an easier way to implement this tip. Instead of renaming EDIT.HLP, simply place a copy of HELP.HLP in another directory, and then rename and modify it.

Next, start EDIT, select Options | Help Path, and point it to the new directory. This way you can easily restore the normal EDIT.HLP at any time. Unfortunately, you won't be able to switch help files in a single edit session. The edit path is not updated until you restart EDIT. Another quirk is that the Help Path is ignored if EDIT.HLP is in the directory in which EDIT was started. Thus you could have DOS HELP available when EDIT is launched from your batch file directory, and normal help available elsewhere.

*Stephen Cerruti
via ZiffNet*

► **PC MAGAZINE:** When you're editing batch files, it's definitely convenient to have the DOS command help file HELP.HLP available at the press of the F1 key. On the other hand, if you're editing a laundry list or a Windows .INI file, you might prefer to get help on using EDIT itself. This tip gives you the best of both worlds.

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Copy HELP.HLP to your batch file directory and rename it to EDIT.HLP. Now you must make the peculiar modification to the file that was mentioned in the original item. If you're a Windows user, load the file into Windows Write, select No Conversion, and locate the string "-9990" in the file. Carefully change the 0 to a 5, save the file, and exit Write. You can also use DEBUG or any byte-level editor to make the change.

Now you have a choice. If you do nothing more, EDIT will provide DOS command help when started in your batch directory, and normal EDIT help everywhere else. That's my own preferred operating mode. If you want DOS command help in EDIT no matter which directory is current, select Help Path from the Options menu and enter your batch file directory (C:\BAT, for example). That will, paradoxically, give you DOS command help in every directory except the one where DOS's utility programs reside!

Another Way to Change the Windows Logo

Your suggestion for changing the Windows start-up logo (December 6, 1994) was interesting, but you'd probably have to resort to using your Windows installation disks. Here's an easier technique: Just enter the following on the command line:

```
COPY /B WIN.CNF + VGALOGO.LGO  
+ VGALOGO.RLE WIN.COM
```

This creates a new WIN.COM file that includes the necessary components to start Windows. The files in question must reside in the current directory, or you'll need to supply the pathnames. The .RLE file must be 16-color and smaller than 640-by-480, and must be small enough so that the

```
@ECHO OFF  
IF NOT EXIST %1 GOTO NoGood  
COPY /B C:\WINDOWS\SYSTEM\WIN.CNF + C:\WINDOWS\SYSTEM\VGALOGO.LGO + %1 C:\WINDOWS\WIN.COM  
GOTO End  
:NoGood  
ECHO File %1 does not exist.  
:End
```

Figure 1: This batch file automates a procedure for changing your Windows start-up logo; edit it if C:\WINDOWS is not your Windows directory.

resulting WIN.COM is smaller than 64K. Replace VGALOGO.RLE with any .RLE file that meets these specifications.

*Thor Vadstein
Stavanger, Norway*

► **PC MAGAZINE:** You can normally make simple changes to the Windows video setup without dragging out your Windows disks, but for the command line enthusiast this is definitely a more flexible solution. And as Mr. Vadstein points out, you don't even need to rename your .RLE file to WINLOGO.RLE. If you find yourself changing the start-up logo frequently, you could automate the process with a batch file like the one in Figure 1. To change the Windows start-up logo, just pass the .RLE filename to this batch file.

If you opt to type the COPY command directly, switch to the Windows system directory first, as that's where the WIN.CNF and VGALOGO.LGO files reside. Note also that WIN.COM should reside in the Windows directory, so after you've successfully recreated it with this command you'll need to move it there.

With either logo-changing method, there's no need to keep a backup copy of WIN.COM. You can always recreate WIN.COM by restoring the original VGALOGO.RLE.

Printing to a File in Windows

Here's a handy technique that lets you print to a file from any Windows application, including System Editor, File Manager, Notepad, and Calendar. Open Windows' Control Panels group and double-click the Printers icon. Click on the Add>> button. Select the Generic/Text Only driver. Click the Install... button (you'll need the Windows installation disks). Now the printer should appear in the Installed Printers section at the

top of the screen. Select the line that says Generic/Text Only on LPT1:. Press Connect. Scroll down through the Ports section until you see FILE:; select FILE:, then OK, and then Close. Now you can select this printer in your applications any time you need to print to a file.

*Matthew Justice
Bryan, Texas*

► **PC MAGAZINE:** This technique is indeed handy for printing data from any Windows program to a file. Of course, by printing with the Generic/Text Only printer driver you lose any formatting information that may have been present, such as bold face or underlining. That doesn't matter if your purpose is simply to get the data into a form that can be manipulated and used by another program. But if, for instance, you're printing to a file on your laptop so you can print to paper when you reach the office, a variation on this solution will let you retain your formatting.

Perform the printer installation as above, but instead of selecting Generic/Text Only, choose the driver for the printer on which you eventually plan to print the document. Connect it to FILE:, as above, and print your document. Windows will prompt for a filename. Later, when your printer is available, simply copy the file to the printer with this command:

```
COPY /B FILENAME.EXT PRN
```

The output file is not just text—it's an image of the data that would be sent to your printer. Look at it with your favorite text-file viewer and you'll probably see a lot of seemingly random characters, with your text embedded among them. One of those characters might be a Ctrl-Z; that's why we add the /B (for binary) switch to the COPY command.

You can use this technique to delay your printing or to print on a different machine. For example, suppose system

A has a fantastic word processor but a lousy printer. System B has a superb printer but no word processor. For your most important documents, you can print to a file on system A and copy the file to the printer on system B. □

Tutor

BY JEFF PROSISE

No Matter How You Spell It, Soundex Finds It

One of life's enduring lessons came to me during fifth-grade English class when the teacher wrote the letters *GHOTI* on the board and challenged the class to pronounce the word she had just written. After exhausting what seemed to be every possible answer, including the obvious ones like "go-tee" and "got-eye," we gave up and asked her for the solution. The answer? "Fish." Take GH as in "tough," O as in "women," and TI as in "dictionary," and *GHOTI* sounds just like *fish*.

The lesson, of course, was that the English language is one for which there are exceptions to almost every rule, especially when it comes to spelling and pronunciation. Most people would see the name *Robbyn* and know that it is an alternative spelling for *Robin*. But a computer program that performs a literal text search—on "Robin" will fail to turn up "Robbyn," because a literal text search requires an exact match. A smart text-retrieval program should realize that both spellings have the same pronunciation. Ever wonder why telephone information operators are less likely to ask you for the spelling of a name nowadays? The software that they use compares names phonetically, so exact spellings aren't needed.

The secret to the phone company's software is actually no secret at all. It's a widely used algorithm called *Soundex*, which was developed early in this century by Margaret K. Odell and Robert C. Rus-

sel at the U.S. Bureau of Archives to simplify census taking. Soundex isn't perfect, but it is relatively easy to implement in software and is surprisingly effective at matching words that are spelled differently but pronounced the same (or almost the same). Here's an inside look at how it works, and a sample program that puts Soundex to work on your PC.

ASSUMPTIONS The Soundex algorithm makes the following assumptions about words in the English language:

- Vowels contribute less to the sound of a word than consonants do and may therefore be disregarded unless they occur at the beginning of a word.
- The letters H, W, and Y make only minor contributions to the sounds of most words and therefore can also be disregarded—again, unless they appear at the beginning of a word.
- Consonants such as M and N can be lumped together into groups of similar-sounding letters.
- Similar-sounding consonants that appear together in a word (such as NN, SS, and MN) sound a lot like single consonants, and for analytical purposes can be reduced to a single consonant sound.

Soundex works by reducing any word into a four-digit code that quantifies how that word is pronounced. If the codes for two words match, then the words sound roughly the same. The procedure for generating a Soundex code goes like this:

1. Starting with the word's second letter, scan from left to right and replace each letter with the corresponding nu-

meric code from Figure 1. "Robbyn," therefore, becomes R01105.

2. Repeat the scan and remove all zeros from the word, effectively eliminating vowels and the letters H, W, and Y. R01105 now becomes R115.

3. Repeat the scan again, this time condensing consecutive occurrences of any code to a single numeric digit. R115 is reduced to R15.

4. If the resulting code is less than four characters long, pad it with 0s so that its length is exactly four. If the code is longer than four characters, truncate the length to four. R15 therefore becomes R150.

The result of step 4 is the Soundex code for the word you started with. This process yields a Soundex code of R150 for "Robbyn." Follow this procedure for "Robin" and you'll find that its Soundex code is also R150. Thus, a text-search program that utilized the Soundex algorithm would correctly equate "Robbyn" and "Robin." A very unconventional spelling such as "Rhubben" would pose no problem either, since it also has a Soundex code of R150.

That such an elementary algorithm can correctly match *Robin* and *Robbyn* is pretty amazing when you think about it. The difference between BB and B is enough to trip up many a search algorithm. The use of I in one name and Y in the other makes word matching even more difficult, and further reduces the likelihood that a conventional search algorithm would turn up a match.

On the other hand, Soundex is far from perfect. It sometimes turns up

Soundex Character Codes

Code	Letters
0	A, E, H, I, O, U, W, Y
1	B, F, P, V
2	C, G, J, K, Q, S, X, Z
3	D, T
4	L
5	M, N
6	R

Figure 1: To characterize words by how they sound rather than how they're spelled, the Soundex algorithm replaces the letters on the right with the numeric codes on the left. Zeros are later eliminated and each consecutive occurrence of the same code is then reduced to a single occurrence.

```

/*
 * Program to search text files for soundlike words using the Soundex
 * algorithm. Published in the Volume 14, Number 10 issue of PC
 * Magazine.
 */

#include <stdio.h>
#include <string.h>
#include <ctype.h>

int cmpline (char *, char *);
int getword (char *, char *);
int scodeequal (char *, char *);
void soundex (char *, char *);

main (int argc, char *argv[])
{
    FILE *file;
    char line[256], scode[4];

    if (argc < 3) {
        printf ("Syntax: PS filename string\n");
        return 1;
    }

    if ((file = fopen (argv[1], "rt")) == NULL) {
        printf ("Error: File not found\n");
        return 2;
    }

    soundex (scode, argv[2]);

    while (fgets (line, sizeof (line), file) != NULL) {
        if (cmpline (line, scode))
            printf (line);
    }

    fclose (file);
    return 0;
}

int cmpline (char *line, char *scode)
{
    char scode2[4];
    char word[256];
    int count, i;

    i = 0;
    while ((count = getword (word, &line[i])) != -1) {
        soundex (scode2, word);
        if (scodeequal (scode1, scode2))
            return 1;
        i += count;
    }
    return 0;
}

int getword (char *dest, char *src)
{
    int i, j;

    i = j = 0;

    while (!isalpha (src[i])) {
        if ((src[i] == 0x00) || (src[i] == 0x10))
            return -1;
        i++;
    }

    while (isalpha (src[i]))
        dest[j++] = src[i++];

    dest[j] = 0x00;
    return i;
}

int scodeequal (char *scode1, char *scode2)
{
    return ((scode1[0] == scode2[0]) && (scode1[1] == scode2[1]) &&
        (scode1[2] == scode2[2]) && (scode1[3] == scode2[3])) ? 1 : 0;
}

void soundex (char *scode, char *string)
{
    static char lettervals[26] = {
        0x00, 0x01, 0x02, 0x03, 0x00, 0x01, 0x02, 0x00, 0x00,
        0x02, 0x02, 0x04, 0x05, 0x05, 0x00, 0x01, 0x02, 0x06,
        0x02, 0x03, 0x00, 0x01, 0x00, 0x02, 0x00, 0x02
    };

    int i, j, len;

    // Initialize the buffer holding the Soundex code
    _strncpy (string);
    scode[0] = string[0];
    scode[1] = 0x00;
    scode[2] = 0x00;
    scode[3] = 0x00;

    // Exit now if the string length is 1
    len = strlen (string);
    if (len == 1)
        return;

    // Replace the letters in the string with code numbers
    for (i=1; i<len; i++)
        string[i] = lettervals[string[i]-0x41];

    // Copy the coded string to the buffer, eliminating 0xFF
    // codes and consecutive codes of the same value
    i = j = 1;
    while ((i < 4) && (j < len)) {
        if ((string[j] != 0x00) && (string[j] != string[j-1]))
            scode[i++] = string[j];
        j++;
    }
}

```



Figure 2: This C program finds all lines containing words that sound like a word you specify. Just enter it on the command line with a filename and the word you're searching for as parameters.

words that hardly sound alike, such as *society* and *scud* (both of whose Soundex codes are S230). While it nominally equates PH and F since H is ignored and P and F fall into the same group, it fails to match them if they occur at the beginning of a word, as in *phone* and *fone*. It also fails to recognize such obvious matches as *rough* and *ruff* since F and G are in different groups. And it fails on *wood* and *would* because silent consonants are not recognized.

Clearly there is room for improvement. That's why almost every implementation of Soundex is individually refined to meet certain needs. No implementation is perfect: The inconsistency of the English language makes sure of that. Modify the algorithm to encode GH as if

it were an F, for example, and you incorrectly encode the sounds of words such as *doghouse*. Still, Soundex in any of its forms is superior to a literal text search, which is guaranteed to miss the close ones.

SEE FOR YOURSELF Figure 2 shows the C source code for a simple text-retrieval program that relies on a common variation of the Soundex algorithm to identify words based on sound rather than spelling. The program, which I call PS (for Phonetic Search), searches a text file and prints lines containing words that sound like a word you specify. The command

PS MYPHONES.TXT JOHNSON

searches the file named MYPHONES

.TXT and displays all lines containing names that sound like Johnson, including variations like Johnssen, Johanson, and even Johanneson. You can use PS for fun, or you can use it as a search engine for information stored in an ASCII text file. If you happen to be a C programmer, you can tweak the algorithm to try Soundex variations of your own. And if you don't have a C compiler handy, you can download the program file (as well as the source code) archived as PS.ZIP. Look in Library 3 (Tutor) of PC MagNet's Utilities/Tips Forum. (Note: Be sure you use PS on plain text files and not on documents stored in a word processor's native format. Those document files may contain text, but they are not text files.)

One way to put PS to work is to use a text editor to build a database of names, addresses, and phone numbers. Each line in the text file constitutes one "record" in the database and may contain up to 255 characters. There is no limit on the length of the file itself. Start each field in the same column on every line. Names might begin in column 0, for example, addresses in column 24, and phone numbers in column 64. This way the output from PS will line up nicely in columns. Then if the text file is named NAMES.TXT and you want to list all the Johnsons or those with similar names in your database, type

```
PS NAMES.TXT JOHNSON
```

or

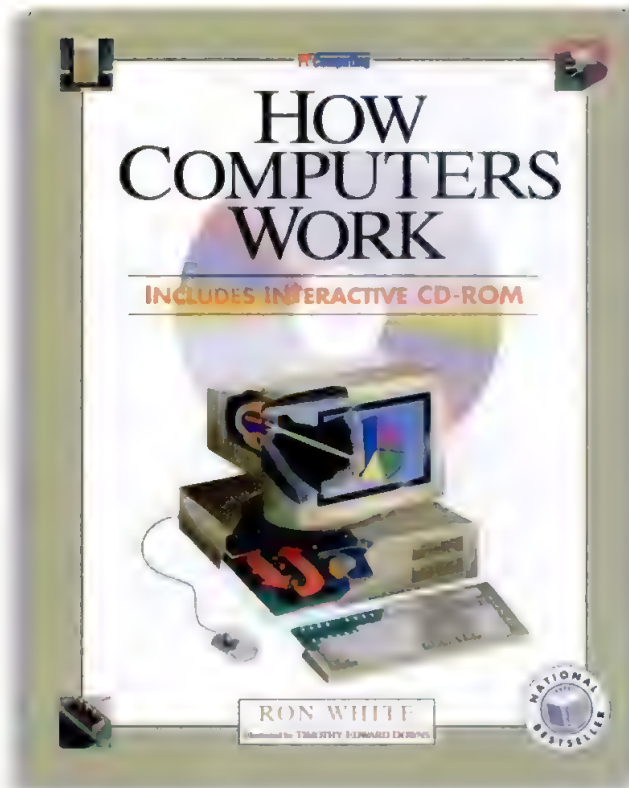
```
PS NAMES.TXT JONSUN
```

Either will work just fine. (To print the output, add >LPT1 to the end of the command; output will be redirected to the printer attached to LPT1.) With PS, you're no longer tied to an exact spelling. Now you can search on Procise—the most common misspelling of my last name—and the search will succeed.

The code that generates a four-digit Soundex code from a zero-delimited ASCII string is localized in the soundex() function. My version makes one minor modification to the basic Soundex algorithm, a variation that is common in programs that use Soundex. Rather than reducing consecutive occurrences of the same digit to single digits *after* eliminating zeros, soundex() reduces them before. This way, two soundalike consonants separated by a vowel don't get lumped together into one consonant sound. If you wish to try out your own variations of the algorithm, all you have to do is modify the soundex() function; the remainder of the program can stay the same.

There are certainly more-sophisticated text-matching algorithms out there, but none that pack as much into a small space as Soundex. It provides computers a simple yet effective way to recognize soundalike words. But don't just take my word for it; give PS a try and see for yourself. □

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Power Programming

BY JEFF PROSISE

Adding Tooltips to Your Win 95 Apps

If you've used the latest versions of Microsoft Word for Windows or Excel, you've no doubt seen those little yellow boxes that pop up with a description when the pointer pauses over a toolbar button. Called *tooltips*, these diminutive windows provide on-the-fly feedback to the user and can greatly enhance the usability of an application. Buttons with pictures on them might look good, but what they do is not always clear. Tooltips reduce the ambiguity of user interface elements by automatically offering plain-text descriptions. They are effortlessly activated, and they go away when no longer needed.

Windows 95 augments the familiar assortment of controls such as push buttons, list boxes, and edit windows with 15 new control types collectively known as the common controls. One of the new controls is the tooltip control, which allows developers to add Word- and Excel-style tooltips to their applications. Some of the new common controls have tooltip support built in, but with the tooltip control at your disposal, you can dispense tooltips at will, attaching them to any window or any part of a window. And once you create a tooltip control, there's very little else you have to do. The control does most of the work, deciding when to pop up, when to go away, and how to paint itself on the screen.

If you're a developer, now is a great time to get acquainted with tooltip controls, especially if you're concerned about giving your application's user interface that extra edge. This article introduces the Windows 95 tooltip control and presents sample code demonstrating its use. The sample program was built and tested on a beta 3 build of Windows 95 distributed to

selected beta sites in February. Therefore, the usual caveat applies: The code will probably work fine with future releases, but there's always a chance it will have to be modified.

TOOLTIP BASICS Tooltip controls and other common controls are contained in the dynamic link library COMCTL32.DLL, which is provided with every copy of Windows 95. Header information is found in the file COMMCTRL.H, and applications that use common controls must be linked with COMCTL32.LIB.

Before creating a common control, your application must call the InitCommonControls function to load COMCTL32.DLL and register the various control classes. InitCommonControls accepts no parameters, so a call to it looks simply like this:

```
InitCommonControls ();
```

A good time to do this is during WM_CREATE processing. Your app only needs to call InitCommonControls once, no matter how many controls your application creates. Moreover, you needn't call FreeLibrary or any other API function to unload COMCTL32.DLL before your program terminates.

Once COMCTL32.DLL is loaded, you create a tooltip control by calling CreateWindow or CreateWindowEx and specifying the window class TOOLTIPS_CLASS. Creating a tooltip control for a

top-level window is typically done during WM_CREATE processing; for a dialog box it's done when a WM_INITDIALOG message arrives. You may, of course, create the control whenever you would like, provided you've already called InitCommonControls. The following statement uses CreateWindow to create a tooltip control:

```
hwndTooltip = CreateWindow(
    TOOLTIPS_CLASS, NULL,
    0, CW_USEDEFAULT,
    CW_USEDEFAULT,
    CW_USEDEFAULT,
    CW_USEDEFAULT, hwnd,
    NULL, hInstance,
    NULL);
```

hwnd is the handle of the parent window, and hInstance is the instance handle. By default, a tooltip is displayed only when the window that owns the tooltip control is the active window. If you also want

If you're a developer, now is a great time to get acquainted with tooltip controls, especially if you're concerned about giving your apps an edge.

tooltips displayed when the owner is inactive (for example, when it is behind a foreground window), specify the style TTS_ALWAYSSTIPS when creating the control. Do not specify the style WS_CHILD unless you want windows containing tooltip text to be clipped to the borders of the parent.

Think twice before using TTS_ALWAYSSTIPS; after all, some users might find it alarming to see tooltips popping up from the background.

When you have created the tooltip control, your next task is to assign tools to it. A "tool" can be an entire window (usually a control window such as a push button or combo box) or an arbitrary rectangle within a window's client area. You register tools by sending TTM_ADDTOOL messages to the tooltip control with wParam equal to 0 and lParam holding the address of a TOOLINFO structure. TOOLINFO is defined in COMMCTRL.H as follows:

```
typedef struct {
    UINT cbSize;
```



```

UINT      uFlags;
HWND      hwnd;
UINT      uId;
RECT      rect;
HINSTANCE hinst;
LPSTR     lpszText;
} TOOLINFO;

```

You must initialize the `cbSize` field with the size of the structure, in bytes. If the tool you're registering is a control window, set `uFlags` to `TTF_IDISHWND` (not `TTF_WIDISHWND` as the SDK prescribes), `uId` to the control's window handle, and `hwnd` to the handle of the window that owns the control. If the tool is a rectangle within your application's own window, set `uFlags` to 0, `hwnd` to the application's window handle, and `uId` to an integer ID that uniquely identifies the rectangle. Also, be sure to initialize `rect` with the rectangle's coordinates.

The `TOOLINFO` structure's `lpszText` field holds a pointer to a text string, the ID of a string resource, or the special constant `LPSTR_TEXTCALLBACK`. If `lpszText` identifies a string resource, you must initialize `hinst` with the program's instance handle so that the tooltip control can retrieve the string resource. If `lpszText` holds a string pointer, the string to which the pointer refers will be shown when the tooltip is displayed. If you want to, you can change the text assigned to a tool by sending the tooltip control a `TTM_UPDATETIPTTEXT` message at a later time.

Or you can register to provide tooltip text on the fly using callbacks by setting `lpszText` equal to `LPSTR_TEXTCALLBACK`. The window identified by `hwnd` will then receive `TTN_NEEDTEXT` notifications in the form of `WM_NOTIFY` messages whenever tooltip text is needed.

When the `TOOLINFO` structure is initialized, the tool that it describes is registered with `SendMessage`:

```

SendMessage (hwndTooltip,
             TTM_ADDTOOL, 0, (LPARAM) &ti);

```

One tooltip control can handle any number of tools, so `TTM_ADDTOOL` messages can be sent as your application requires.

After you create and initialize the tooltip control, your work is mostly done. If we assume none of the `lpszText` fields contain `LPSTR_TEXTCALLBACK` constants so that you needn't respond to `TTN_NEEDTEXT` notifications, your application's only remaining responsibility is to relay mouse events to the tooltip control so it can tell where the mouse pointer is, how long it has remained motionless, and whether a mouse button has been pressed or released.

This is necessary because mouse messages are directed not to the tooltip control itself but to the window over which the pointer is positioned. When the pointer moves within the bounding rectangle of a tool, the tooltip control sets a timer for 0.5-second (500 milliseconds) intervals. If the

timer fires and the pointer has not moved, the tooltip control displays the appropriate tooltip window. You can change the delay time by sending the control a `TTM_SETDELAYTIME` message with `lParam` equal to the new delay time in milliseconds. For example, the statement

```

SendMessage (hwndTooltip,
             TTM_SETDELAYTIME, 0, 1000);

```

changes the delay time to 1 second.

Mouse events are relayed to the tooltip control via `TTM_RELAYEVENT` messages sent with `wParam` set to 0 and `lParam` holding the address of a `MSG` structure containing the message parameters. Your application should ensure that `WM_MOUSEMOVE`, `WM_LBUTTONDOWN`, `WM_LBUTTONUP`, `WM_RBUTTONDOWN`, and `WM_RBUTTONUP` messages are relayed to the control. An application that registers one or more rectangles within its client area might relay mouse messages like this:

```

MSG msg;

.
.
.

case WM_MOUSEMOVE:
case WM_LBUTTONDOWN:
case WM_LBUTTONUP:
case WM_RBUTTONDOWN:
case WM_RBUTTONUP:
    if (hwndTooltip != NULL) {
        msg.hwnd = hwnd;
        msg.message = message;
        msg.wParam = wParam;
        msg.lParam = lParam;
        SendMessage (hwndTooltip,
                     TTM_RELAYEVENT, 0,
                     LPARAM) &msg;
    }
    break;

```

This way, the tooltip control is apprised of all mouse events that occur within the window and can judge when a tooltip window should be displayed.

Relaying mouse messages is slightly more difficult when a tool is a control window rather than a rectangle within your application's client area. Why? Because your application's window doesn't receive mouse messages when the pointer is posi-

Tooltip Messages

Message	Description
<code>TTM_ACTIVATE</code>	Activates a tooltip control
<code>TTM_ADDTOOL</code>	Adds a tool to a tooltip control
<code>TTM_DEACTIVATE</code>	Deactivates a tooltip control
<code>TTM_DELTOOL</code>	Deletes a tool from a tooltip control
<code>TTM_ENUMTOOLS</code>	Enumerates tools attached to a tooltip control and retrieves information about each tool
<code>TTM_GETTEXT</code>	Retrieves the text assigned to a tool
<code>TTM_GETTOOLCOUNT</code>	Retrieves the number of tools assigned to a tooltip control
<code>TTM_GETTOOLINFO</code>	Given a tool ID, retrieves information about a tool
<code>TTM_HITTEST</code>	Determines whether the mouse pointer is over a tool and, if so, retrieves information about that tool
<code>TTM_NEWTOOLRECT</code>	Changes a tool's bounding rectangle
<code>TTM_RELAYEVENT</code>	Relays mouse events to a tooltip control
<code>TTM_SETDELAYTIME</code>	Changes a tooltip control's delay time, the period of time the pointer must remain motionless over a tool before a tooltip is displayed (default=0.5 second)
<code>TTM_SETTOOLINFO</code>	Changes the parameters assigned to a tool
<code>TTM_UPDATETIPTTEXT</code>	Changes the text assigned to a tool

Figure 1: These are the messages that applications can send to a tooltip control in order to issue commands and extract information.

tioned over a control window; rather, the control does. To trap these mouse messages and relay them to the tooltip control, your application must intercept messages to the control by subclassing the control or installing a message hook.

Suppose, for example, that you've created a tooltip control and assigned tooltips to several push buttons. You can install a message hook to intercept messages destined for the buttons with the following function call:

```
SetWindowsHookEx (WH_GETMESSAGE,
HookProc, NULL,
GetCurrentThreadId ());
```

Now messages intended for the button controls will pass through your HookProc procedure first. HookProc examines all incoming messages and relays mouse messages to the tooltip control before passing them on to the buttons. You'll see an example of this in the next section.

Tooltip controls support a number of messages that application programs can use to send commands and extract information. Figure 1 briefly summarizes these messages. We've already discussed the

TTM_ADDTOOL,
TTM_RELAY-
EVENT, TTM_SET-
DELAYTIME, and
TTM_UPDATE-
TIPTEXT messages.
Other messages you
might find useful in-
clude TTM_ACTI-
VATE and TTM_DE-
ACTIVATE, which
enable and disable a
tooltip control (a dis-
abled control does not
display tooltips, even

if the pointer pauses over a tool); TTM_NEWTOOLRECT, which changes the coordinates of a rectangle tool; and TTM_HITTEST, which allows your application to determine whether the mouse pointer is over a specified tool and, if so, to retrieve information about that tool. You can find additional information concerning these messages in the Windows 95 SDK.

TOOLTIPS IN ACTION To demonstrate tooltip controls, I have written a C program named TICTAC. You can down-

load the source code, TICTAC.C, TICTAC.EXE, and TICTAC.MAK, the Visual C++ 2.0 make file, from PC MagNet's Programming Forum libraries, archived as TICTAC.ZIP. The GDI painting logic was partially broken in the build of Windows 95 on which I tested TICTAC, so depending on what build you're running and what video driver you are using, the colors TICTAC draws on the screen may be displayed incorrectly. Presumably this will be fixed before beta 3 is released to the general public.

TICTAC is a tic-tac-toe program: You place X's and O's in

the squares by clicking the left mouse button, and when three X's or O's are lined up in a row, TICTAC displays a message box announcing the winner. What's unique about TICTAC is that it uses tooltips to jazz up its user interface. The buttons labeled Clear and Exit are assigned tooltip text; so are the nine squares in the tic-tac-toe grid and the empty rectangle below the buttons. Figure 2 shows

the TICTAC window with four squares filled in and a tooltip window explaining what will happen if the user clicks in the square underneath the pointer. Because clicks of the left mouse button alternate between X's and O's (the first click places an X, the second places an O, the third an X, and so on),

the tooltips in these squares save the user from having to track X's and O's mentally. To someone unfamiliar with tic-tac-toe, the tooltips also help communicate the rules of the game.

Take a moment to play with TICTAC and see the tooltip messages for yourself. Hold the pointer over one of the push buttons and after a brief pause, a tooltip window with the message "Clear the grid and start a new game" or "Terminate this application" will appear. Move the mouse or click a button and the message will dis-

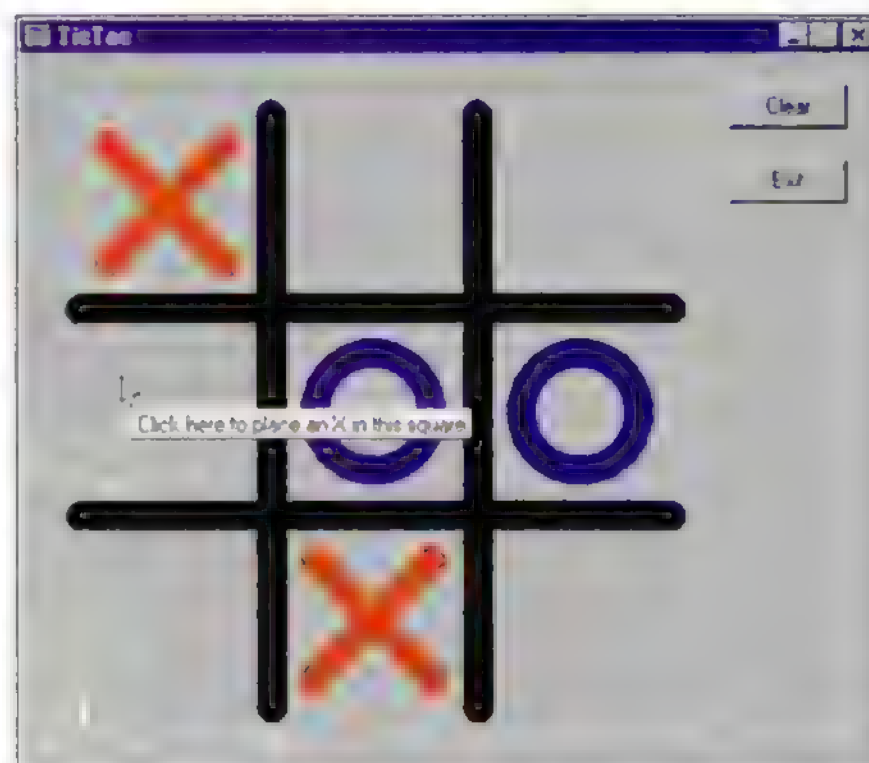


Figure 2: Here is how the TICTAC window appears with a tooltip displayed.

appear. Hold the mouse pointer over the blank rectangle beneath the push buttons and the message "Rent this space! Call 800-xxx-xxxx today" will appear. And hold the pointer over an empty square in the tic-tac-toe grid and the message "Click here to place an X in this square" or "Click here to place an O in this square" will pop up. Not bad for a program that contains less than 500 lines of code—especially when most of that code is devoted to the game itself, and only a small part of it is directly related to tooltips.

The three sets of tools in the TICTAC window—the buttons, the empty rectangle below, and the squares in the tic-tac-toe grid—share the same tooltip control, but each interacts with the control in a different way. The blank rectangle, which serves no useful purpose in the program other than to demonstrate one manner of using tooltips, illustrates the simplest use of a tooltip control. Right after the tooltip control is created in TICTAC's WM_CREATE handler, the rectangle is registered as a tool by filling in a TOOLINFO structure and sending a TTM_ADDTOOL message to the tooltip control:

```
ti.cbSize = sizeof (TOOLINFO);
ti.uFlags = 0;
ti.hwnd = hwnd;
ti.uId = 0xFFFF;
CopyRect (&ti.rect, &rcLittle);
ti.lpszText = "Rent this space!
Call 800-xxx-xxxx today.";
```



```
SendMessage (hwndTooltip,
    TTM_ADDTOOL, 0, (LPARAM) &ti);
```

ti.uFlags is 0 because we're registering a rectangle, not a control window. ti.hwnd is equal to TICTAC's window handle; ti.uld is set to the arbitrary ID value 0xFFFF; and ti.rect is initialized with the coordinates of the rectangle itself. And because ti.lpszText is initialized with a pointer to a string, the tooltip control will automatically display a tooltip window of the appropriate size when the pointer stops over the rectangle. All that's left is to make sure TICTAC relays mouse messages to the tooltip control.

TICTAC's WM_LBUTTONDOWN handler relays left-button click messages to the tooltip control before it performs any processing on those messages itself. The code to relay the messages looks like this:

```
if (hwndTooltip != NULL)
    msg.hwnd = hwnd;
    msg.message = message;
    msg.wParam = wParam;
    msg.lParam = lParam;
    SendMessage (hwndTooltip,
        TTM_RELAYEVENT, 0, (LPARAM)
        &msg);
}
```

You'll find identical code in the handler that processes WM_MOUSEMOVE, WM_LBUTTONUP, WM_RBUTTONDOWN, and WM_RBUTTONUP messages. The code in these handlers relays to the tooltip control all mouse messages pertaining to events in the client area of the TICTAC window, so the code serves not only the do-nothing rectangle but also the squares in the tic-tac-toe grid.

The squares in the grid demonstrate how an application can specify tooltip text dynamically. Each of the nine squares is registered as a rectangle with the tooltip control, and each sets ti.lpszText equal to LPSTR_TEXTCALLBACK so that the tooltip control will send a TTN_NEEDTEXT notification before displaying a tooltip. A for loop in TICTAC's WM_CREATE handler performs the registrations:

```
for (i=0; i<9; i++) {
    ti.cbSize = sizeof (TOOLINFO);
```

```
    ti.uFlags = 0;
    ti.hwnd = hwnd;
    ti.uld = i;
    CopyRect (&ti.rect, &rcGrid[i]);
    ti.lpszText = LPSTR_
        TEXTCALLBACK;
    SendMessage (hwndTooltip,
        TTM_ADDTOOL, 0, (LPARAM) &ti);
}
```

The rcGrid array holds the rectangles' coordinates. Note that each tool is assigned a unique ID from 0 to 8. That's important, because TICTAC needs to know which square a TTN_NEEDTEXT notification pertains to.

TICTAC responds to TTN_NEEDTEXT notifications by trapping WM_NOTIFY messages. When a WM_NOTIFY message arrives, lParam points to a TOOLTIPTTEXT structure, which is defined as follows in COMMCTRL.H:

```
typedef struct {
    NMHDR    hdr;
    LPSTR    lpszText;
    char      szText[80];
    HINSTANCE hinst;
} TOOLTIPTTEXT;
```

hdr is a structure itself, containing code, hwndFrom, and idFrom fields. For a TTN_NEEDTEXT notification sent by a tooltip control, code is set to TTN_NEEDTEXT, hwndFrom holds the handle of the tooltip control, and idFrom holds the ID of the tool to which the notification pertains. TICTAC verifies that a notification is indeed a TTN_NEEDTEXT notification from the tooltip control and that it applies to one of the squares in the tic-tac-toe grid (idFrom holds a value from 0 to 8). TICTAC then replaces the question mark in the message string "Click here to place an ? in this square" with the ASCII code for X or O and copies the string's address to the TOOLTIPTTEXT structure's lpszText field; or, TICTAC sets lpszText to NULL, indicating that nothing should be displayed. If the former occurs, the tooltip control displays the string in a tooltip window. The core code is contained in the following statements:

```
if (nGrid[(lpttt->hdr).idFrom]
    == 0) {
    szText[23] = (char) nSymbol;
```

```
    lpttt->lpszText = szText;
}
else
    lpttt->lpszText = NULL;
```

The variable named nSymbol holds the ASCII code for X or O and always indicates which symbol will be placed next. As an alternative to setting lpszText to a string address, TICTAC's WM_NOTIFY handler could have copied the string itself to the structure's szText field, or set hinst to the program's instance handle and copied a string resource ID to lpszText.

The effect of all this is that when the user places the mouse pointer over an empty square in the grid, TICTAC displays a tooltip message indicating whether clicking will place an X or an O in the square. The use of TTN_NEEDTEXT notifications is necessary because the text of the tooltip depends on the playing grid's current state. Grid values themselves are stored in the nGrid array, which contains one element for each square in the grid. Each individual element holds 0, HAS_X, or HAS_O, indicating that the corresponding square is unmarked, holds an X, or holds an O.

The tooltip code for the Clear and Exit buttons illustrates a third aspect of programming tooltip controls: how tooltips are applied to control windows. After creating the buttons in its WM_CREATE handler, TICTAC registers the buttons as tools with the following statements:

```
ti.cbSize = sizeof (TOOLINFO);
ti.uFlags = TTF_IDISHWND;
ti.hwnd = hwnd;
ti.uld = (UINT) hwndClear;
ti.lpszText = "Clear the grid and
    start a new game";
SendMessage (hwndTooltip,
    TTM_ADDTOOL, 0, (LPARAM) &ti);

ti.cbSize = sizeof (TOOLINFO);
ti.uFlags = TTF_IDISHWND;
ti.hwnd = hwnd;
ti.uld = (UINT) hwndExit;
ti.lpszText = "Terminate this
    application";
SendMessage (hwndTooltip,
    TTM_ADDTOOL, 0, (LPARAM) &ti);
```

This time uFlags is set to TTF_IDISH-

WND, indicating that we're registering windows rather than rectangles, and `uId` is initialized with the controls' window handles. Accordingly, TICTAC's `WM_CREATE` handler installs a message hook to intercept messages directed to the button controls. The hook procedure `HookProc` filters out mouse messages and relays them to the tooltip control as follows:

```
message = ((MSG *) lParam)->message;

if ((nCode >= 0) &&
    ((message == WM_MOUSEMOVE) ||
     (message == WM_LBUTTONDOWN) ||
     (message == WM_LBUTTONUP) ||
     (message == WM_RBUTTONDOWN) ||
     (message == WM_RBUTTONUP)))

    SendMessage (hwndTooltip,
        TTM_RELAYEVENT, 0, lParam);

return (CallNextHookEx (hHook,
    nCode, wParam, lParam));
```

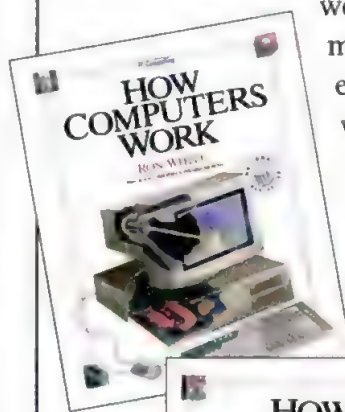
Again, this is necessary because otherwise neither the tooltip control nor TICTAC's window procedure would know when the mouse pointer is over a control window. After relaying a message or deciding that the message is not a mouse message, `HookProc` calls `CallNextHookEx` to pass the message down the chain to other hook procedures (if present) and ultimately to the message's intended target. TICTAC cleans up after itself during `WM_DESTROY` processing by calling `UnhookWindowsHookEx` to deinstall the message hook.

These are only a few examples of the ways you can use tooltip controls to enhance a user interface. Now that the tooltip control is a standard part of the operating system, don't let Microsoft's application developers get the better of you. When appropriate, build tooltips into the applications that you write. Your users will thank you. □

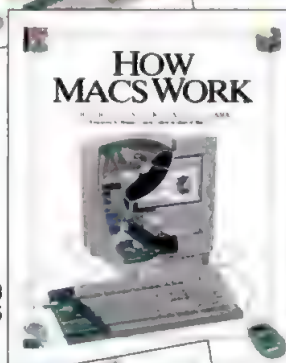
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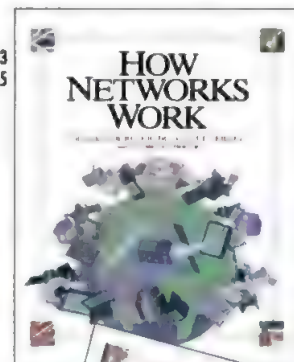
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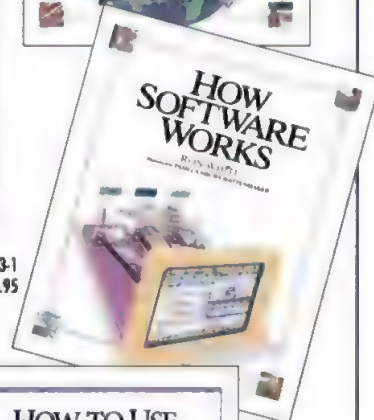
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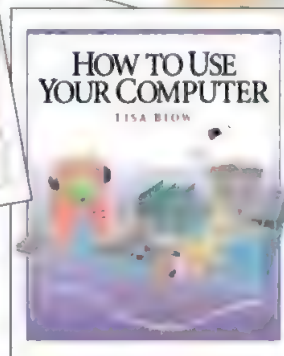
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Utilities

BY DOUGLAS BOLING

Save the Desktop!

Jung observed that "In all chaos there is a cosmos, in all disorder a secret order." Graphical user interfaces have allowed disorder to proliferate on the computer screen. Over the years, I have taken this disorder to a higher level: It would be hard to find a more cluttered desktop than my own. It pains me to turn off my machine and lose my "secret order" when Windows shuts down. Sure, Windows remembers my Program Manager setup, but why doesn't Windows save the entire state of the desktop as IBM's Warp does? Well, now Windows can too, with SaveIt.

SaveIt, this issue's free utility, remembers the programs that are running when you shut down your Windows session and automatically restarts them when you restart Windows. Since most programs today remember their window position, SaveIt will restore the desktop to the look it had when your last Windows session ended.

If saving your desktop sounds like a neat (or perhaps messy) idea, you can download SaveIt from *PC Magazine's* PC MagNet. (See the sidebar "Guide to Our Utilities & How to Get Them" for instructions.) If you are interested in how SaveIt performs its magic, the C source code and other necessary files are available as well. To compile SaveIt you will need a C compiler compatible with Microsoft C 6.0 or Borland's C++ 3.1. If your compiler does not include the files necessary to produce Windows executables, you will also need the Microsoft Windows Software Development Kit.

USING SAVEIT To use SaveIt, copy the SaveIt executable file, SAVEIT.EXE, to a directory on your hard disk, then run it by selecting the File | Run menu item in Program Manager. When run, SaveIt will display a small window with only one button: Exit (see Figure 1).

The Exit button shuts down SaveIt. But since SaveIt must be running if you want it to save the desktop, choosing Exit triggers the reminder message also shown in Figure 1. Instead of exiting SaveIt, minimize it by clicking on the minimize button in the upper-right corner of the window. If SaveIt is running when you exit Windows, then the next time you start Windows, SaveIt will be launched and will in turn launch all the programs that were running when you exited.

For SaveIt to restart DOS sessions, you have to take some special measures. Windows' default PIF settings prevent you from shutting down DOS sessions by selecting Close from the System menu. This means Windows will not shut down while any DOS box is running, so SaveIt won't restore these DOS sessions. To change this, edit the PIF for each of your DOS programs (Windows uses _default.pif for DOS programs without an associated PIF) so you have "Allow Close When Active" in Windows' PIF editor. I have done this for my command line window that is running COMMAND.COM.

Remember, however, that DOS programs such as editors that handle critical data should not be closed this way. Refer to the documentation for your DOS programs to determine whether closing while active is allowable.

Of course, SaveIt cannot know everything about the programs running. If you start Word for Windows by double-clicking on a Word document in File Manager, SaveIt will launch Word for Windows with this document opened. But if you closed the document file during your Word for Windows session and opened a different one, SaveIt has no way of knowing the document being edited was changed.

Another limitation is that SaveIt does not know what DOS programs you may be running from a DOS command line. But if you started a DOS program directly from Program Manager or File Manager, SaveIt will restart that program.

INSIDE SAVEIT The design of SaveIt is not complicated. Essentially, SaveIt checks which programs are running when Windows is shutting down, then removes programs that start automatically from its list of running programs. This list is then saved in the SAVEIT.INI file. When you restart Windows, SaveIt launches the programs listed in its .INI file. Simple.

Before I delve deeper into SaveIt, a review of how Windows shuts down and restarts would be helpful. A program can attempt to shut down a Windows session using one of two calls: ExitWindows or ExitWindowsExec. The ExitWindows function takes two parameters: dwReturnCode (a double word value) and a reserved word.

The misnamed dwReturnCode is not a return value passed back to DOS. Rather it is a flag indicating how Windows should process the ExitWindows call. If the dwReturnCode parameter is zero, ExitWindows just ends the current Windows session. If the dwReturnCode value contains the constant EW_RESTARTWINDOWS, ExitWindows ends the current session and restarts Windows. If dwReturnCode contains EW_REBOOTSYSTEM, ExitWindows ends the current session and reboots the computer. In this case, Windows would be restarted only if a WIN command is in AUTOEXEC.BAT.

The description of the ExitWindows function has changed dramatically from

Top 10 Utilities

Rank	Utility
1	FDDLLS - Finds dead DLLs
2	FINDIRQ - IRQ line analysis
3	WTIME - Keeps PC clock accurate
4	INCTRL - Controls Windows installation
5	MYGRPS - Customizes group icons
6	WINCMD - Command file interpreter
7	BUGS - Windows 3.1 screen saver
8	PLIGON - Places program icons
9	SCHEDULER - Runs programs automatically
10	PASTE - Enhanced Windows clipboard

This list is based on the total number of downloads each utility has had on PC MagNet over the past month. To download these files, type GO ZNT:TIPS. For more information, see the sidebar "Guide to Our Utilities & How to Get Them."

Windows 3.0 to Windows 3.1. The Windows 3.0 documentation reverses the meanings of the two parameters, labeling the first double-word parameter as reserved and the second word parameter as wReturnCode. Also in the 3.0 documentation, the wReturnCode value is described as the value Windows returns to DOS as its return code. While this value has no meaning if Windows is restarted or the system is rebooted, it can be valuable for those times where the Windows session is simply terminated.

The ExitWindowsExec function provides a convenient way for an application to end a Windows session, run a DOS application, and return to Windows after the DOS application has closed. This function takes two parameters: a pointer to a string containing the DOS application to run and a pointer to the parameters to pass to the DOS application.

Both ExitWindows and ExitWindowsExec return a Boolean value indicating the success or failure of the functions. While it might seem strange that a function shutting down Windows could fail, it is a common occurrence. The reason is that all Windows applications are notified that Windows is shutting down and must agree to the shutdown. Most users know that shutdown will fail if a DOS session is running and the PIF says not to "Allow

a user request. For instance, a word processor will not shut down if you click the "Cancel" button after being notified that a document has not been saved.

When Windows begins its process of shutting down, it notifies all top-level windows by broadcasting two messages. The first message is WM_QUERYENDSESSION, which asks all the running applications permission to shut down. If any application returns a zero value, indicating it does not want Windows to shut down, Windows cancels its shutdown procedure and continues to run normally. So even if an application agrees to the WM_QUERYENDSESSION message, it cannot assume Windows is actually shutting down, because another application could refuse the shutdown request.

If all applications agree to shut down, then Windows sends a WM_ENDSESSION message to all of them with the wParam value set to TRUE (non-zero), indicating that Windows is shutting down. If one or more applications refuses to shut down, Windows sends the applications that did agree to shut down a WM_ENDSESSION message with wParam set to FALSE, informing them that Windows is not shutting down.

Now that we have covered the shutdown process, it is time to see what happens when Windows is started. When you start Windows, it looks at the Shell= key in the [Boot] section of SYSTEM.INI to get the name of the program to use as the Windows shell program. This line is similar to the SHELL= line in CONFIG.SYS that DOS uses to find its shell program. Typically, the Shell= key contains the name PROGRAM.MAN.EXE, which is the name of the Program Manager's .EXE file.

When the Program Manager starts, it looks in the [Windows] section of WIN.INI for the contents of the RUN= and LOAD= keys. These keys contain

names of programs, separated by at least one space, that are to run when Windows is started. The programs listed in the RUN= key are executed so that they run as open windows. The programs listed in the LOAD= key are executed as icons.

In Windows 3.1, another automatic way to run programs when Windows is

first loaded is to place them in the Startup group. This user-friendly method allows more control over each program. You can specify a startup directory, command line parameters, a hot key, and a specific icon. You can also prevent Startup-group programs from executing by holding down the Shift key while

Windows is loading. Though less convenient, the LOAD= and RUN= lines do have one important advantage in that they are processed before the Startup group. With the LOAD and RUN keys, you can ensure that a given program is loaded first.

Now that we have reviewed how Windows starts and ends, it is time to look again at SaveIt. SaveIt's functions can be divided into four parts: knowing when Windows is shutting down, determining the programs running when the shutdown occurs, knowing what programs the Program Manager will start when Windows restarts, and launching the appropriate programs when Windows restarts.

Detecting that Windows is shutting down is simply a matter of checking for the WM_QUERYENDSESSION and WM_ENDSESSION messages. When SaveIt receives a WM_QUERYENDSESSION, it performs the work to determine what programs need to be started next time. The list of these programs is then saved in SaveIt's .INI file. SaveIt returns TRUE when it processes the WM_QUERYENDSESSION message to indicate it is okay for Windows to shut down. When the WM_ENDSESSION message is received, a check of the wParam parameter is made to be sure that Windows is indeed shutting down. If so, SaveIt adds its program name to the LOAD= line so that it will be started

.....
*Knowing what programs
are running at any given
time is somewhat tricky.*
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.....

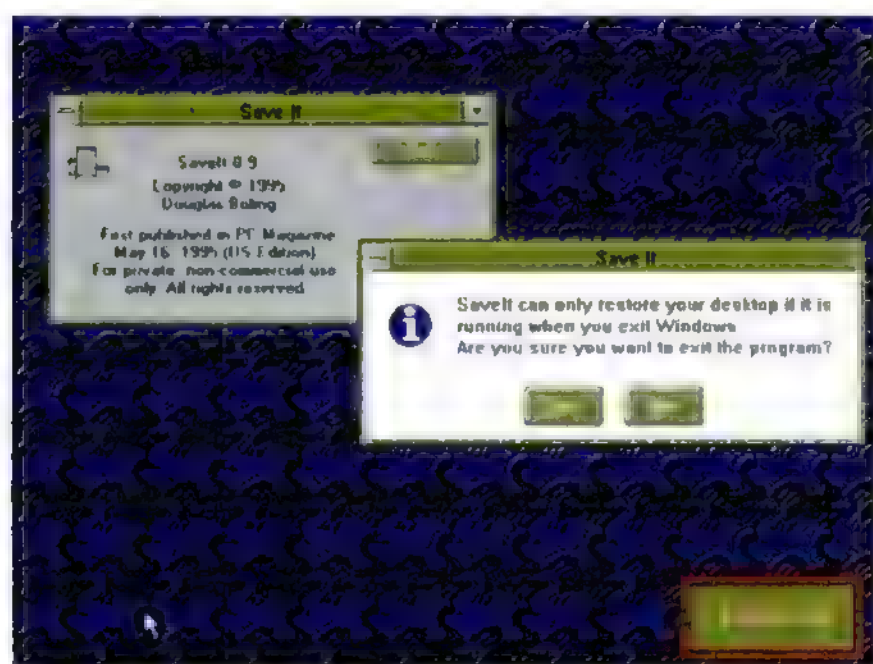


Figure 1: SaveIt displays the window on the left when first run, and the message box on the right when you try to exit.

Close When Active," but shutdown can fail under other circumstances too.

For example, a Windows communications program may refuse to allow Windows to shut down if the program is in the middle of downloading a file. Or a program may refuse to shut down because of

when Windows is started next. Also, a flag is set in the SAVEIT.INI file to launch SaveIt's list of programs when Windows (and SaveIt) is started again.

Knowing what programs are running at any given time is somewhat tricky. The method used by SaveIt is to scan the windows on the desktop. In almost all cases, a Windows program must create and maintain at least one window on the desktop. Therefore, looking at the windows on the desktop gives a very good idea of the programs that are running. Of course, a program may have more than one window on the desktop, so some work must be performed to remove duplicate tasks from the program list SaveIt is assembling.

SaveIt uses a simple principle to enumerate the programs currently running. First, the handle of the desktop is determined by calling the GetDesktopWindow() function. The first child window of the desktop is queried using the GetWindow() function with the GW_CHILD parameter. Then the children of the desktop are queried in turn by calling the GetWindow() function with the GE_HWNDNEXT parameter. The query loop looks something like this:

```
// Get the first child window of the
// desktop.
hwndNext = GetWindow (GetDesktop
    Window(), GW_CHILD);
// Loop through each window on the
// desktop
while (hwndNext) {
    .
    . Process window stuff
    .
    hwndNext = GetWindow (hwndNext,
        GW_HWNDNEXT);
}
```

SaveIt's goal is to relaunch all running programs in their current state. This requires some additional information. Of course, the name of the program is necessary, and the current working directory for the program is also necessary. Any command line parameters used to start the program should also be determined. Finally, if a program's window is minimized or maximized at shutdown, it should be restarted in that condition. SaveIt stores

```
typedef struct {
    char cIdentifier[4]; // ASCII identifier 'PMCC'
    WORD wChecksum; // Checksum of the group file
    WORD cbGroup; // Documented as the size of the group
    // file but is actually the offset of
    // the start of the TAGDATA list
    WORD nCmdShow; // ShowWindow parameter that describes
    // how the group window should appear
    // in the program manager
    RECT rcNormal; // Size and position of the group window
    POINT ptMin; // Position of the icon when minimized
    WORD pName; // Pointer to the group file name
    WORD wLogPixelsX; // Expected horizontal resolution
    WORD wLogPixelsY; // Expected vertical resolution
    BYTE bBitsPerPixel; // Expected bpp for the display
    BYTE bPlanes; // Expected planes for the display
    WORD Reserved; // Number of programs listed in the display
    WORD cItems; // ITEMDATA structures
    rgItems[];
} GROUPHEADER;
typedef struct {
    POINT pt; // Position of the program's icon
    WORD iIcon; // Index into the executable for the icon
    WORD cbResource; // Size of the icon resource in bytes
    WORD cbANDPlane; // Size of the AND plane of the icon
    WORD cbXORPlane; // Size of the XOR plane of the icon
    WORD pHeader; // Pointer to the resource header for the icon
    WORD pANDPlane; // Pointer to the AND plane of the icon
    WORD pXORPlane; // Pointer to the XOR plane of the icon
    WORD pName; // Pointer to the icon title in the file
    WORD pCommand; // Pointer to the command to launch the program
    WORD pIconPath; // Pointer to the name of the icon file
} ITEMDATA;
typedef struct {
    WORD wID; // Specifies type of data in the structure
    WORD wItem; // Specifies what program item the tag refers to
    WORD cb; // Specifies size of the tag data
    BYTE rgb[1]; // Start of data for this tag
} TAGDATA;
```

The wItem in the TAGDATA structure can have the follow values:

```
0x8000 - First tag structure in the list
0x8101 - Tag contains the path for the program
0x8102 - Tag contains the hot key for the program
0x8103 - Specifies that the program should be started minimized
0xFFFF - Last tag structure in the list
```

Figure 2: This is the layout of the structures used in the Group file format.

these four parameters for each program. The trick is finding this information.

A window handle is the key to almost any information about the window or the program that created the window. For example, if it knows the window handle, a program can query the instance handle for the program that created the window using GetWindowWord(). With the instance handle of a program, its name can be queried using the GetModuleEXEName() function as in

```
char szProgName[256];
HINST hInst;

hInst = GetWindowWord (hwndNext,
    GWW_HINSTANCE);
GetModuleFilename (hInst,
    szProgName, sizeof (szProgName));
```

With the window handle and the GetTaskWindow() function, the task handle of the program that created the window can be queried. A handy use of the task handle is to eliminate multiple windows created by the same task, because each program has a unique task handle. By examining the task handle for a window, SaveIt can determine if information for that task has already been queried. But that is not the most important use of the task handle when gathering information about a running program.

A task handle is actually a selector for a block of global memory where data concerning the task is kept. So by just converting the task handle—more accurately, task selector—into a pointer to the global memory block of the selector, we make a pointer to the task data block. The follow-



ing code fragment converts a window handle into a task handle and then into a pointer to the task block.

```
hTask = GetWindowTask (hwndNext);
lpTaskBlk = MAKELP (hTask, 0);
```

The task block contains a wealth of information about its assigned task. Windows stores such basic information as the saved stack pointer for the task when it is not active and the control word for the floating-point coprocessor. For a complete discussion of the format of the task block, refer to the informative book *Undocumented Windows* by Schulman, Maxey, and Pietrek. SaveIt, however, is interested only in a program's current drive and directory and its starting command line parameters, if any. Once you have a pointer to the task block, knowing the offsets of the relevant data in the block is all that is necessary.

The current drive for the task is kept in a byte at offset 66h. The base value for drives is 80h and increases one for each drive. For example, drive A: is encoded as 80h, B: is 81h, and C: is 82h. Converting this value into a drive letter can be accomplished with the following line of code:

```
driveletter = *(lpTaskBlk + 0x66)
              - 0x80 + 'A';
```

The current directory for the task can be found in an ASCII string starting at offset 67h of the task block. Windows maintains separate "current directories" for each task in the system.

Another piece of information necessary to SaveIt is the command line used when starting the program. While most Windows programs are started without command line parameters, this component is necessary for those that are. Of particular interest is the WinOldApp module that Windows uses to execute DOS applications under Windows.

When WinOldApp is started, the name of the DOS application to be run (or the PIF that specifies the DOS application) is passed on the command line. The command line is located at offset 180h of the task block. The format of the command line is a length byte followed by the command line. DOS programmers will recognize this format as the same for-

mat used in the DOS Program Segment Prefix (PSP) found in DOS programs. Actually, Windows maintains a DOS-like PSP for each task. The PSP for a task is conveniently located at offset 100h in the task block.

Once SaveIt has gathered the necessary information for each program running, it must determine which of these programs will be automatically started by the Program Manager when Windows restarts. To do this, SaveIt creates a start-up list by examining the LOAD= and RUN= lines in WIN.INI and the programs listed in the Startup group in the Program Manager. Parsing the lines in the .INI file is simple; each program name is separated by one or more spaces. It is parsing the Startup group file that takes some effort.

Microsoft documented the format for Program Manager group files in the Windows 3.1 SDK. Each group file starts with a header called GROUPHEADER that describes the general nature of the group, including its location in the Program Manager window and the number of programs in the group. Following the header is an array of ITEMDATA structures that define information for each program listed in the group. The array is followed by a list of TAGDATA structures that contain additional data for each program added in the Windows 3.1 implementation of Program Manager. Figure 2 shows a layout of each of these structures.

SaveIt opens the Program Manager's .INI file, PROGMAN.INI, to determine the location of the Startup group file. Once found, the group file is read into memory and parsed based on the structures shown in Figure 2.

Once the list of startup programs has been gathered, it is compared with the list of programs currently running. Any programs common to the two lists are removed from the list of running programs. Then SaveIt stores the names of the programs it needs to start, along with the relevant directory and window-state information, into its own .INI file.

When you restart Windows, SaveIt automatically starts, because SaveIt's install routine adds its name to the LOAD= line in WIN.INI. SaveIt checks its .INI file for a flag indicating that it was running the last time Windows was exited. If so, it

launches the programs listed in its .INI file, minimizes itself, and quietly awaits the next time Windows shuts down.

AN ALTERNATIVE METHOD Another method for determining what programs are running at any given time is in *Undocumented Windows*. The book demonstrates a method of walking the Windows Task list to determine the programs that are running. While this is not the way SaveIt accomplishes the task, it is an interesting technique because it illuminates how Windows manages the many different programs running on the system.

The task blocks I described earlier that are maintained for each program are actually formed into a list. Instead of tracing the windows on the desktop to determine the running tasks, a program can instead examine the list of task blocks. Scanning the task list is accomplished by knowing two undocumented facts about how Windows handles tasks.

The first trick to walking the task list is to know that the documented function GetCurrentTask() returns the undocumented handle to the head of the task list in the high word of the return value. *Undocumented Windows* gets at this information by redefining the GetCurrentTask() declaration to return a DWORD value. Another method is the following routine:

```
HTASK GetHeadTask (void) {
    HTASK hHead;

    _asm {
        call GetCurrentTask
        mov hHead,DX
    }
    return hHead;
}
```

With the handle to the first task in the list, a pointer can be formed to the first task block in the list. The programmers at Microsoft conveniently placed the handle of the next task in the list in the first word of the task block. The last task block contains a 0 in this word. So a loop to walk the task list would look like this:

```
hTaskNext = GetHeadTask()

while (hTaskNext) {
    lpTaskBlk = MAKELP (hTask, 0);
```

```

. Gather task information
.
hTaskNext = (HTASK far *)lpTaskBlk;
}

```

Of course, once the task handle is discovered, the other necessary information can be gathered. The only remaining chore is obtaining information about the

windows created by the task. You can get a list of window handles for each task using the EnumTaskWindows() function.

While SaveIt uses a top-down approach to gathering data, the method in *Undocumented Windows* is more of a bottom-up approach. Either method works satisfactorily. In fact, during the design stage, I implemented versions of SaveIt that used each method. I went with the top-down ap-

proach to demonstrate a method different from the one in *Undocumented Windows*.

SaveIt is a small program, but it accomplishes a big task: keeping my messy desktop as messy as it was last time I ran Windows. Try SaveIt and remember: There is always someone messier than you! □

DOUGLAS BOLING IS A CONTRIBUTING EDITOR OF PC MAGAZINE.

GUIDE TO OUR UTILITIES & HOW TO GET THEM

SaveIt

PURPOSE: SaveIt restores your Windows desktop to the state it was in when you shut Windows down. Programs that were running when you exited Windows are reopened. If the program used command line options or loaded files using the command line, the options and files are also restored.

SETUP: To install SaveIt, copy the SaveIt executable file, SAVEIT.EXE, to a directory on your hard disk, then run it by selecting the File | Run menu item in the Program Manager. Click on the Install button, then minimize SaveIt. SaveIt must be running for it to work.

REMARKS: If SaveIt was running when you exited Windows, then when you restart Windows, SaveIt automatically starts and launches all the programs that were previously running. Clicking on the Exit button will shut down SaveIt and disable it. After installation, the Install button changes to an Uninstall button, which you can use to remove SaveIt from your system.

FILES: SAVEIT.DOC—just the documentation file.
SAVEIT.EXE—just the executable program.
SAVEIT.ZIP—the source code, program, and documentation files.

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HARDWARE

Mouse MIA

❓ I would like to know how to make Windows 3.1 recognize a mouse on COM3 or COM4. I've tried loading the mouse driver in DOS with MOUSE /3 before starting Windows, and while this makes the mouse work in DOS applications, it doesn't help in Windows. I also tried changing the COM1 settings in the Windows Control Panel to the COM3 address, but that doesn't work either. I can't use COM1 or COM2 for the mouse, since I have software that requires both of them already, and it can't be changed. A bus mouse would solve the problem, but I don't have room for one without making major modifications to my system. Can you help?

*Don Frisbee
via fax*

► **PC MAGAZINE:** Sorry, but you're out of luck. Microsoft made a design decision that its Windows mouse driver would not support COM3 or COM4. Windows loads its own mouse driver and completely ignores the DOS driver. The only reason for loading a mouse driver before starting Windows is to be able to use the mouse in DOS applications that you run in a DOS session within Windows. And even if Windows did let you put the mouse on COM3, COM3 and COM1 share the same IRQ, so you'd quite likely have an IRQ conflict with your COM1 device.

You didn't mention why your existing software requires two serial ports and why they must be COM1 and COM2, but if you don't need to use both ports simultaneously, perhaps you could use a serial switching device so that both devices could be connected to a single serial port instead of taking up both.

Otherwise, the bus-mouse route seems to be your best bet. Perhaps by doubling up the functions of your existing expansion cards (such as I/O ports and disk controller) you could free up a slot for the bus-mouse interface.—*Alfred Poor*

Green Thumb?

❓ I never turn off my computers, because they receive data transmissions around the clock—including weekends. And of course I use these computers during work hours, but I do turn off the monitors when I'm not using the computers. This means I turn the monitors on and off about twice a day; I believe this produces less heat and lowers my electric bill. Is there anything wrong with this practice?

*Paul Kamrath
Columbus, Nebraska*

► **PC MAGAZINE:** There's nothing wrong with this practice, and weighing the various factors, it's a reasonable approach to saving energy.

The only downside is that the wear and tear on a monitor occurs primarily at power up and power down, both on such mechanical components as the on-off switch, and on the electronic components, including capacitors and the display tube filament.

The advantage is that you do eliminate a major portion of your system's power consumption by turning off the monitor. In fact, this is essentially what happens in the highest levels of energy-saving designs such as VESA DPMS (display power management signaling) systems. They shut off everything inside the monitor except for enough circuitry to start things up again when a key is pressed. If you are willing to use your thumb instead of a special graphics adapter or screen saver, you essentially achieve the same end with no additional cost.—*Alfred Poor*

Upgrading Your UART

❓ I've updated my computer by replacing its 386DX/33 processor with a new 486DLC/33. I'd like to improve the speed of serial communications, but my motherboard COM ports use the old 8250 UARTs. Can I upgrade by replacing them with 16550 chips?

*Harry League
Arlington Heights, Illinois*

► **PC MAGAZINE:** The UART (Universal Asynchronous Receiver/Transmitter) chips used by older computers can't handle the throughput required by today's 14.4-Kbps and 28.8-Kbps modems. The 16550 has a 16-byte buffer that can reduce

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See index, page 286.

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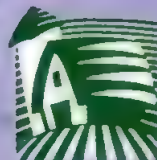
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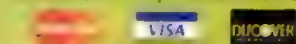
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errors during high-speed serial operations, so if you're using one of these modems, you should definitely consider upgrading your serial ports.

Unfortunately, you can't simply unplug the old chip and plug in the new one, as you did with your CPU upgrade. You can, however, buy a serial-port board that uses 16550 UARTs. As a first step, you'll have to disable the serial ports on your motherboard, but most designs let you do this either through CMOS settings or by changing jumpers on the motherboard.

I/O cards with 16550 chips are readily available for \$40 or less. If you don't have an available expansion slot, but you do have an IDE paddle card, you can replace it with a combination I/O card with an IDE interface for less than \$50. Such cards are available for either ISA or VL-Bus motherboards.—*Alfred Poor*

■ OPERATING ENVIRONMENTS

Enhanced-Mode Requirements

❓ My friend's computer shows an icon that indicates his machine is running Microsoft Windows in 386 Enhanced

mode. I have a 286-based system with 2MB of RAM, and I've never been able to put my system into 386 Enhanced mode. Can you tell me how to do this? What would I gain by running in 386 Enhanced mode?

*Larry Nielsen
Salt Lake City, Utah*

► **PC MAGAZINE:** Unfortunately, one of the requirements for running Windows in 386 Enhanced mode is a system with an 80386 or better CPU. There's nothing you can do to put a 286-based system into this mode; Standard mode is the best you can

get. Even with a 386-based system, you'd almost certainly need more RAM. Yes, the Windows 3.1 manual says 640K of conventional memory and 1MB of extended memory is enough, but that's an optimistic estimate. The Windows for Workgroups 3.11 manual has revised the requirement up to 3MB total, and 4MB is recommended.

If you do upgrade your system with a 386 processor and more memory, what will you gain? The biggest benefit is *virtual memory*. You can designate a chunk of your hard disk space as a permanent swap file, and Windows will use this disk space to increase (in effect) your available memory. If real memory runs out, Windows will temporarily stash data or programs from RAM into the permanent swap file and swap them back into memory as needed. There are other advantages, like the ability to run non-Windows applications in a window, but virtual memory is the big one.—*Neil J. Rubenking*

Directory Navigation with . and ..

❓ When you are several subdirectories deep, how do you use . or .. to copy files back one or two or up one or two? Suppose I'm in

`C:\MYFILES\RICK\TAXES\1993\NOV`

How, for example, would I copy *.txt from RICK to TAXES without typing in \MYFILES\RICK\TAXES? What's the dot lowdown?

*Rick Trankle
via ZiffNet*

Our Advisors

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Craig Stinson is a contributing editor and coauthor of *Running Windows 3.1* and *Running Microsoft Excel*.

M. David Stone is a contributing editor and coauthor of *Word for Windows Companion*, Second Edition.

Ethan Winer is a contributing editor and the author of *PC Magazine BASIC Techniques and Utilities*.

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► **PC MAGAZINE:** I'm assuming that by "back" you mean toward the root, and by "up" you mean away from the root. We'll use your example directory, and push around an imaginary file named FOO.BAR. If you're in RICK and want to copy to TAXES:

```
COPY FOO.BAR TAXES
```

If you want to copy to 1993:

```
COPY FOO.BAR TAXES\1993
```

Copying "up" is just a matter of including the portion of the directory structure beyond your current location.

To copy from a deeper subdirectory to the current directory, you can use the fact that the current directory is the implied destination of a COPY.

```
COPY TAXES\FOO.BAR
```

or

```
COPY TAXES\1993\FOO.BAR
```

will copy that file to RICK (assuming RICK is the current directory).

The only difference with MOVE is that it does not assume the current directory as destination. You must supply the destination directory. Here's the dot you were asking about! The single dot represents the current directory, so to move a file from TAXES to the current directory RICK, you'd use:

```
MOVE TAXES\FOO.BAR .
```

The double dot represents the parent directory. A directory can have many children, but just one parent, so going toward the root is easier. Say you're in NOV and want to copy to each directory that's closer to the root:

```
COPY FOO.BAR ..
COPY FOO.BAR ...
COPY FOO.BAR ....
COPY FOO.BAR .....
COPY FOO.BAR .....
```

Copying from a parent directory is just the reverse:

```
COPY ..\FOO.BAR
COPY ...\FOO.BAR
```

And again, for MOVE in the second case you must supply the single dot to represent the current directory. For example, to move a file from the parent directory to the current directory:

```
MOVE ..\FOO.BAR .
```

Finally, there's copying *sideways*. It's a good bet that your 1993 directory has a sibling directory (a subdirectory of the same parent) named 1994, and that NOV has a sibling named DEC. If you're in DEC and want to copy to NOV:

```
COPY FOO.BAR ...\NOV
```

If you're in 1993\DEC and want to copy to 1994\JAN:

```
COPY FOO.BAR ...\1994\JAN
```

But Windows' File Manager lets you avoid all this!—Neil J. Rubenking

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Desktop	486DX2/50	270MB	\$1149
Desktop	486DX2/66	420MB	1529
Desktop	486DX4/100	420MB	1719
Minitower	Pentium 75	720MB	2589

Processor	Screen	HD	Price
LTE Elite			
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486DX4/75	9.5" Dual Scan	510MB	3499
486DX4/75	10.4" Active	510MB	5029
486DX4/75	10.4" Active	810MB	5389

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Minitower	Pentium 75	1.28GB	\$2299
Minitower	Pentium 100	1.28GB	2759

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Chassis	Processor	HD	Price
Desktop	Pentium 75	1.28GB	\$1929
Desktop	Pentium 100	1.28GB	2419

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486DX2/50	10.3" Dual Scan	340MB	\$2749
486DX4/75	10.3" Dual Scan	510MB	3149
486DX4/75	10.4" Active	510MB	4129
486DX4/75	10.4" Active	700MB	4519

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All-in-One	486DX2/66	540MB	\$1699*
Desktop	486DX2/66	540MB	1299
Desktop	486DX2/66	540MB	1599
Desktop	Pentium 75	540MB	1999
Minitower	Pentium 75	1GB	2299
Minitower	Pentium 90	1GB	2599
Minitower	Pentium 100	1GB	2799

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Processor	Screen	HD	Price
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486DX4/100	10.4" Dual Scan	340MB	\$4599
486DX4/100	10.4" Dual Scan	540MB	4949
486DX4/100	10.4" Dual Scan	810MB	5399
486DX4/100	10.4" Active	340MB	5599
486DX4/100	10.4" Active	540MB	5999
486DX4/100	10.4" Active	810MB	6399
486DX4/100	10.4" Active	540MB	7049*
486DX4/100	10.4" Active	810MB	7499*

*Features built-in CD-ROM drive

IBM ThinkPad® 360 & 360E

486SL/33	8.4" Active	340MB	\$1999
486DX2/50	9.5" Dual Scan	340MB	2699
486DX2/50	9.5" Dual Scan	540MB	3049
486DX2/50	8.4" Active	340MB	3099
486DX2/50	8.4" Active	540MB	3449

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Processor	Screen	HD	Price
486DX2/50	10.4" Dual Scan	360MB	\$3799
486DX2/50	10.4" Dual Scan	540MB	4149
486DX2/50	10.4" Active	360MB	4799
486DX2/50	10.4" Active	540MB	5149
486DX4/75	10.4" Dual Scan	360MB	4399
486DX4/75	10.4" Dual Scan	540MB	4749
486DX4/75	10.4" Active	360MB	5299
486DX4/75	10.4" Active	540MB	5649

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486DX4/75	10.4" Active	500MB	4679

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T4900CT

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- 10.4" Active Matrix display
- Built-in 16-bit sound, microphone, speaker & MIDI

Processor	Screen	HD	Price
Pentium 75	10.4" Active	772MB	\$5499

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T2100

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- Built-in AC adapter - small, sleek design & reduced weight
- 10.4" Dual Scan display

Processor	Screen	HD	Price
486DX2/50	9.5" Mono	250MB	\$1439
486DX2/50	10.4" Dual Scan	330MB	2249
486DX2/50	8.4" Active	330MB	3099

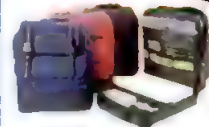
Other Notebooks from Toshiba

Processor	Screen	HD	Price
T4800CT			
486DX4/75	9.5" Active	500MB	\$3559
T4850CT			
486DX4/75	10.4" Active	500MB	\$3889
486DX4/75	10.4" Active	772MB	4099
T3600			
486DX2/50	8.4" Active	500MB	\$3719
T2400			
486DX2/50	9.5" Dual Scan	320MB	\$2449

Processor	Screen	HD	Price
T2450			
486DX4/75	9.5" Active	320MB	\$3299
486DX4/75	9.5" Active	500MB	3799
T1960			
486DX2/50	9.5" Dual Scan	200MB	\$1999
T1910			
486SX/33	9.5" Mono	200MB	\$1299
486SX/33	9.5" Dual Scan	200MB	1749

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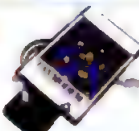
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XJ2144	14.4/14.4 XJACK GOLD	209.99
CC4144	14.4/14.4 PCMCIA GOLD	209.99
XJ2288	28.8 14.4 XJACK	389.99
CC3288	28.8 14.4 PCMCIA	389.99
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Chassis	Processor	MD	Price
Minitower	486DX4/100	540MB	\$1699
Minitower	Pentium 75	850MB	1999
Minitower	Pentium 90	850MB	2299
Minitower	Pentium 90	1.2GB	2699
Minitower	Pentium 100	1.2GB	2999

Versa M

- High Res. displays avail. - 800x600 res. on notebook
- Removable/Reversible display
- Replace floppy w/ 2nd battery for 6-10 hrs. battery life
- Replace floppy w/ Versa Bay - Add extra PCMCIA
- Built-in 16-bit sound, microphone & speaker
- Upgradable hard drive - easily add more storage

Processor	Screen	MD	Price
486DX4/75	9.5" Dual Scan	250MB	\$3049
486DX4/75	9.5" Dual Scan	340MB	3119
486DX4/75	9.5" Active	340MB	3739
486DX4/75	9.5" Active	540MB	3999
486DX4/75	9.5" True Color	340MB	3999
486DX4/75	9.5" High Res.	540MB	4399
486DX4/100	9.5" Active	340MB	4069
486DX4/100	9.5" True Color	540MB	4629
486DX4/100	9.5" Active	810MB	4729
486DX4/100	9.5" High Res.	540MB	4729
486DX4/100	9.5" High Res.	810MB	5099

Versa P

- 75MHz Pentium - for blazing performance
- High Res. displays available - 800x600 res. on notebook (10.4" on selected models)
- Removable/Reversible display
- Replace floppy w/ 2nd battery for 6-10 hrs. battery life
- Replace floppy w/ Versa Bay - Add extra PCMCIA
- Built-in 16-bit sound, microphone & speaker
- Upgradable hard drive - easily add more storage

Processor	Screen	MD	Price
Pentium 75	9.5" Active	340MB	\$4349
Pentium 75	9.5" Active	540MB	4629
Pentium 75	9.5" Active	810MB	4999
Pentium 75	9.5" High Res.	540MB	4999
Pentium 75	9.5" High Res.	810MB	5389
Pentium 75	10.4" Active	540MB	4999
Pentium 75	10.4" Active	810MB	5389
Pentium 75	10.4" High Res.	810MB	5769

Versa V

- Replace floppy w/ 2nd battery for 6-10 hrs. battery life
- Upgradable hard drive - easily add more storage
- 32-bit local bus with 1MB video RAM
- 64K colors on notebook display (Active only)

Processor	Screen	MD	Price
486DX2/50	9.5" Dual Scan	250MB	\$2369
486DX2/50	9.5" Dual Scan	340MB	2499
486DX2/50	9.5" Active	250MB	2889
486DX2/50	9.5" Active	340MB	3029
486DX2/50	9.5" Active	540MB	3399
486DX4/75	9.5" Active	340MB	3399
486DX4/75	9.5" Active	540MB	3779

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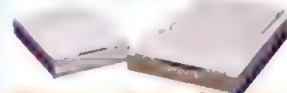
HP Omnibook 600

HP Omnibook 600

- Weighs as little as 3.8lbs.
- Upgradable PCMCIA hard drive - easily add more storage
- Built-in infrared for no hassle printer connections
- Instant "ON" resume feature - lasts up to 1 week.

Processor	Screen	MD	Price
486DX2/50	8.5" Dual Scan	170MB	\$2549
486DX2/50	8.5" Dual Scan	260MB	2829
486DX4/75	8.5" Dual Scan	170MB	3099
486DX4/75	8.5" Dual Scan	260MB	3379

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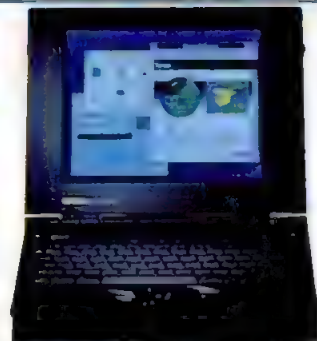
HP DeskJet 320	\$299.99
HP DeskJet 540	289.99
HP DeskJet 560C	479.99
HP DeskJet 1200C	979.99

HP Scanners

HP ScanJet 3P (greyscale)	\$479.99
HP ScanJet IIcx (color)	949.99

HP (Colorado) Tape Drives

Trakker 250MB (portable)	\$269.99
Trakker 350MB (portable)	339.99
Trakker 700MB (portable)	449.99



HP Omnibook 4000

HP Omnibook 4000

- 10.4" Active & 10.3" Dual Scan
- Built-in 16-bit sound, microphone & speaker
- Replace floppy w/ 2nd battery for 5-7 hrs. battery life
- Built-in infrared for no hassle printer connections

Processor	Screen	MD	Price
486DX2/50	10.3" Dual Scan	260MB	\$2499
486DX2/50	10.3" Dual Scan	340MB	2829
486DX2/50	10.3" Dual Scan	520MB	3199
486DX2/50	10.4" Active	340MB	3769
486DX2/50	10.4" Active	520MB	4129
486DX4/100	10.3" Dual Scan	340MB	3619
486DX4/100	10.3" Dual Scan	520MB	3999
486DX4/100	10.4" Active	340MB	4489
486DX4/100	10.4" Active	520MB	4829



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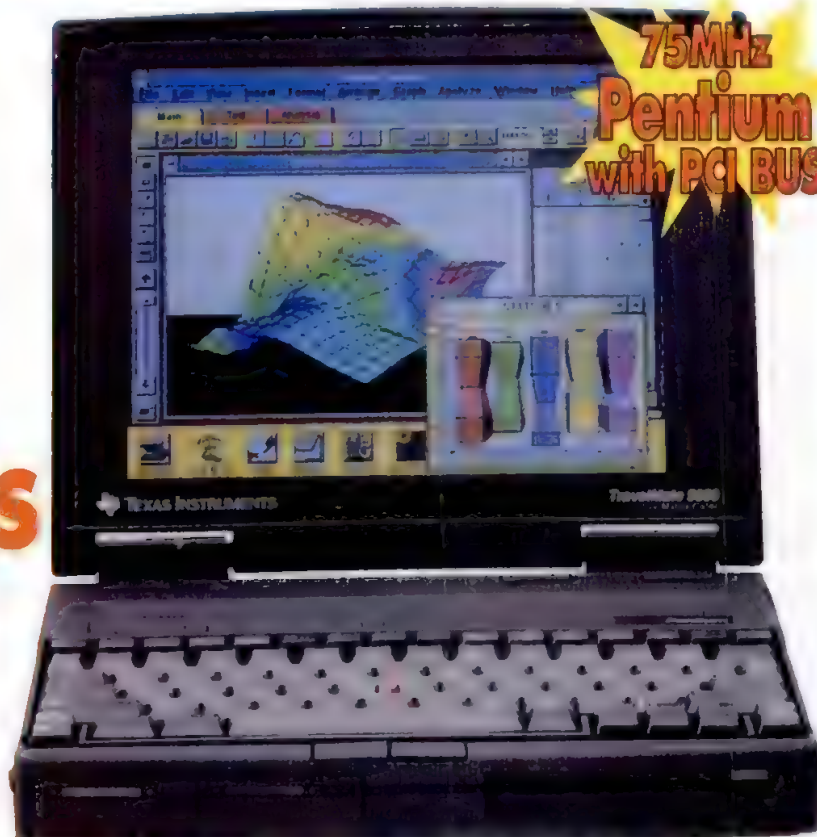
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486DX2/50	8.4" Active	455MB	2629
486DX4/75	9.5" Dual Scan	455MB	2799
486DX4/75	8.4" Active	340MB	3069
486DX4/75	8.4" Active	455MB	3319
486DX4/100	9.5" Active	525MB	4279



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WORD PROCESSING

Sorting Names in WordPerfect and Word

TIP It's easy to sort a list of names in WordPerfect for Windows by first name. Sorting by last name takes a little more work. If every name consisted of only a first and last name, you could easily sort by the second word in the line. But some people use their middle names or initials, such as David N. Dinkins and Hillary Rodham Clinton; some have obligatory titles, such as Sir Anthony Hopkins; and some have titles or other additions after their names, such as F. Lee Bailey Esq. or Hank Williams Jr.

The easiest solution to this problem is to join the trailing Esqs., Jrs., and the like to the last name with a hard space, and then sort by the last word in each line. The hard space acts like another letter in the name rather than a word separator.

Your first step then is to go through the list of names to find the trailing items, and replace the space before each item with a hard space, which you enter with Ctrl-Spacebar. (You may want to use the search-and-replace function if you have a long list.) Next, highlight the list and choose Tools | Sort to open the Sort dialog box. Accept Current Document as both the input and output file, set Sort By to Line, and set the single key definition to Alpha for Type, Ascending for sort order, 1 for Field, and -1 for Word. Choose OK, and WordPerfect will sort the names alphabetically by last name.

*Frank C. Yang
Elmhurst, New York*

►PC MAGAZINE: This approach to sorting works as promised but is limited to cases where there is nothing (such as a mailing address or an e-mail address) following the names. A more general solution is to enter the hard space between the first name and middle name or initial, or between the leading title or initial and the first name. You can then define the sort using most of the same settings, except that you'll need to set Word to 2 in the key definition.

You can use the same concept to sort by last name in Microsoft Word for Windows as well, using nonbreaking spaces (WinWord's version of hard spaces),

which you enter with Ctrl-Shift-Spacebar.

Start by entering the nonbreaking spaces, just as with WordPerfect, and make sure that each name is in a paragraph by itself. You can then highlight the list of names and choose Table | Sort Text, then Options, to open the Sort Options dialog box. Next, choose Other in the Separate Fields At box and enter a space in the text box next to the Other choice. Then choose OK to return to the Sort Text box. Finally, in the first Sort By box, specify Word 2, Text, and Ascending, and choose OK to sort the names.

In my testing Word did not always display all the choices—Word 1, Word 2, Word 3, and so forth—on the first try. When I closed the dialog box and reopened it, however, the missing choices appeared.—*M. David Stone*

DATABASES

Conditional Text in Access Reports

? I am a physician, and I'd like to have Microsoft Access generate reminder letters to my patients to call up for their annual appointments. I'd also like to include some text informing those patients with outstanding balances that they have balances due. How can I include the text only for patients with outstanding balances—and not for those who are all paid up?

*Jennifer Ziedonis
Decatur, Georgia*

►PC MAGAZINE: The simplest way is to use the IIF function. This function lets you test a condition and returns one of two values, depending on whether the condition is true. The function takes three arguments:

```
Iif(<condition>, <true>, <false>)
```

The first is the condition to be tested. The second is the expression to evaluate and return if the condition is true. And the third is the expression to evaluate and return if the condition is false.

For instance, suppose your letter is stored in an Access report design, and you want to add the outstanding-balance sentence to the end of some existing text. To add it, you normally use the string concatenation operator, &, followed by the

```
= "Please call our office at your  
earliest convenience to make your  
next appointment. " & Iif([Balance]>0,  
"We'd also like to remind you  
that you have an outstanding balance  
of " & Format([Balance],  
"$#,##0.00") & ". " , "")
```

Figure 1: This Access expression uses an IIF function to place conditional text on a report. Note that it should all be entered on one line.

text within double quotes. To make the text conditional, however, you enclose it within an IIF function. Figure 1 shows an example expression used to fill a text box.

In the expression in Figure 1, the reminder sentence is only concatenated to the existing text if the amount in the [Balance] field is greater than zero. Otherwise, "" is substituted (a null string), which doesn't add anything at all.

Note that Access automatically wraps the paragraph correctly, whether the conditional text is included or not.

—*Sal Ricciardi*

GRAPHICS

Accurate Line Breaks in QuarkXPress

? I work for a prepress company that is in the process of changing over to desktop publishing using QuarkXPress on Macs. At home I have a Quantex DX4-100 PC, and I plan to purchase QuarkXPress for Windows. I'd like to be able to work at home sometimes, which would involve moving documents back and forth between the office Macs and my home PC.

The documents include .TIF and .EPS files. It is critical that the line spacing and line endings in the document remain the same whenever I switch between the Mac and the PC. I've been told I would need to purchase equivalent fonts for my PC, but the expense would be prohibitive since my company uses hundreds of fonts. Will the Adobe Type 1 fonts used in the Mac-based documents translate properly to my PC?

*Nancy K. Ihm
Dubuque, Iowa*

►PC MAGAZINE: QuarkXPress offers binary compatibility between its Mac and PC versions. This means that when you bring a QuarkXPress document created on a Mac over to Windows, the file will contain all of

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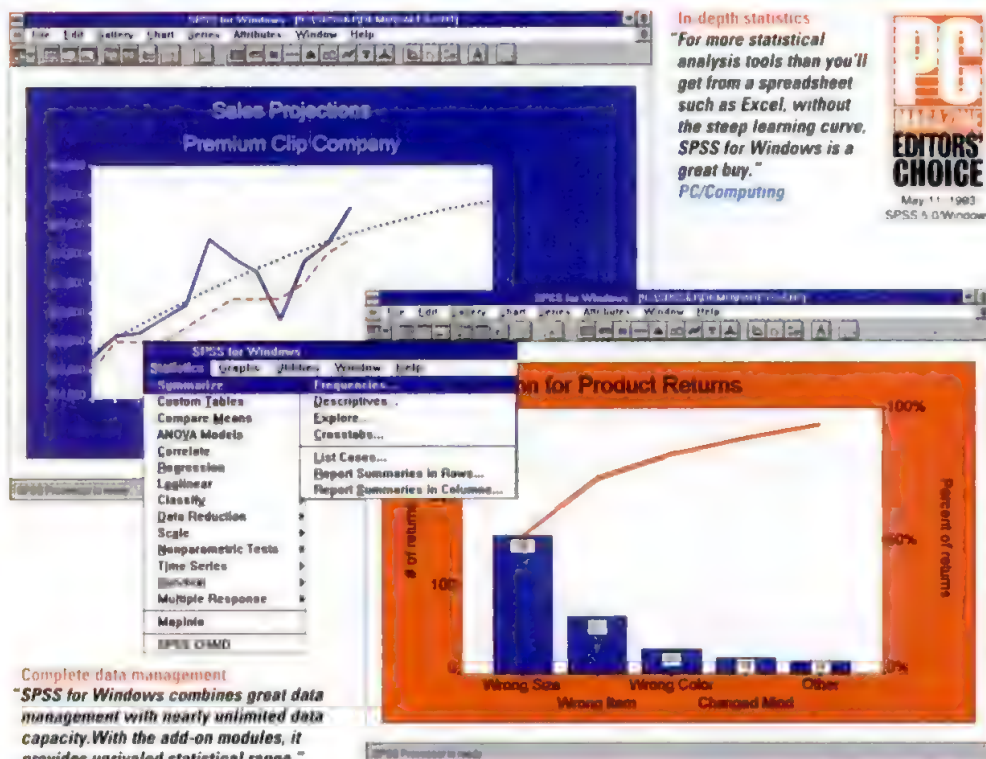
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T2100CT	486DX2/50	8MB	8.4" Active	330MB	\$3046
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T2150CDT	486DX4/75	8MB	10.4" Active	500MB	\$4632
T2400CS	486DX2/50	4MB	9.5" Dual Scan	250MB	\$2254
T2400CS	486DX2/50	4MB	9.5" Dual Scan	320MB	\$2423
T2400CT	486DX2/50	8MB	8.4" Active	250MB	\$2909
T2400CT	486DX2/50	8MB	8.4" Active	320MB	\$2980
T2450CT	486DX4/75	8MB	8.4" Active	320MB	\$3505
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486DX2/50	4MB	9.5" Active	340MB	\$2979
486DX2/50	4MB	9.5" Active	540MB	\$3351
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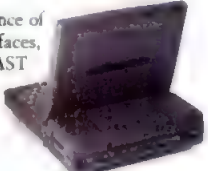
Processor	Ram	Screen	Hard Drive	Price
486DX4-75	8MB	9.5" Dual scan	250MB	\$2997
486DX4-75	8MB	9.5" Active	340MB	\$3678
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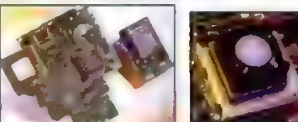
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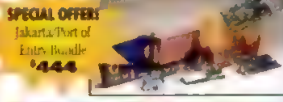
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the words and pictures in the original file—as well as the correct formatting information. But formatting is merely that—a set of instructions that tell Quark which fonts to use when typesetting the copy. The fonts themselves are not embedded into the publication file.

Unfortunately, there is only one way to guarantee absolutely accurate line endings for a wide variety of typefaces: purchase and install identical fonts for your PC. Note that I said *identical*—not equivalent—fonts. Fonts from different type foundries that look similar or that share the same name may actually have different character widths, different x-heights, and different kerning values. Even minor discrepancies in these characteristics can cause dramatic changes to line endings when text is reflowed.

At the moment, you have only one other solution, and it is admittedly deficient. This solution requires that you do only layout work at home—no typography changes are allowed. When you open the

Mac document on the PC, QuarkXPress will search your system for the fonts contained in the publication. If it doesn't find the requested typeface, it will present you with the Font Usage dialog box. Instead of substituting new fonts for the missing fonts, simply click on the Continue button. Quark will load the document using whatever font is your current default font. But Quark will not change the Stylesheets, so although the line breaks will be inaccurate on your PC, the text will reflow correctly when the publication is once again opened up on the Mac.

Don't give up hope, though. In a few months you should be able to purchase a nearly perfect solution to your problem. The next version of Adobe Type Manager (ATM) will support on-the-fly font substitution using Adobe's Multiple Master technology. Here's how it will work: When you open a file—any file—ATM will look through the fonts installed on your system. If it doesn't find the requested font, it will use a Multiple Master font instead, usually chosen on the basis of whether the original

font was a serif or sans serif typeface. The important point is that ATM will use the font metric data (that is, read character widths) of the original fonts (it stores this information in its own internal database) to reshape the substitute Multiple Master font. Though the font won't be identical to the original, all of the line breaks will be preserved. At the moment, only SuperATM, Version 3.8, on the Mac supports Multiple Master font substitution. The current version of ATM for Windows (3.0) is one iteration behind its sibling.

Multiple Master technology does have some shortcomings. In addition to buying ATM 3.x (\$60), you'll probably have to purchase a few Multiple Master fonts (starting at a list price of \$195). And though SuperATM will store the font metrics for a large number of Type 1 fonts (and even some TrueType fonts) it won't contain data for every font on the market. So you may find that an unusual font just isn't in the database. But even with these limitations, ATM Multiple Master tech-

The only way to get accurate line endings when transferring documents between PCs and Macs is to use identical fonts.

nology promises that you will be able to work on your home PC without duplicating all of the fonts installed on your office Mac. Contact Adobe for more information on the release date at 415-961-4400.

The only other potential problem I can foresee concerns the

use of pictures in your publications. If you import only .TIF and Adobe-conforming .EPS files, you should have no trouble opening the documents on your PC, because both TIFF and EPS are platform-independent standards. Avoid .PICT files (which are specific to the Mac) and .BMP files (which are specific to the PC). You may also want to consider importing only low-resolution images into your documents for positioning purposes. This will make the file smaller and easier to transport. If you subsequently need to move the high-resolution images that are stored externally along with the publication file, use the "Collect for Output" option on the File menu to gather the publication and all of the relevant pictures into one subdirectory.—Luisa Simone □

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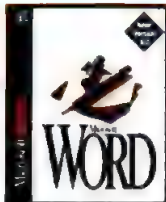
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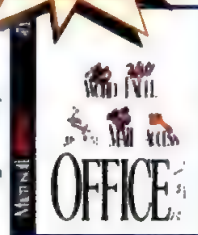
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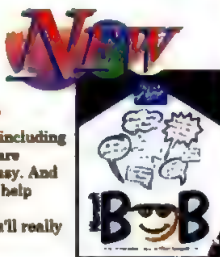
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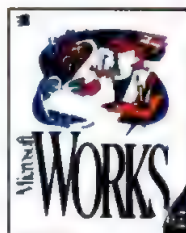
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Versa M 4/75 340MB dual cr	3142.60
Versa M 4/75 340MB act cr	3755.78
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ML320	299.88	Pacemarker 3410	1213.95
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 - Enhanced IDE interface
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 - 10-Key Enhanced Keyboard
 - Microsoft DOS 6.22
 - Microsoft Windows for Workgroups
 - Transporter Menu System
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 - 14.4 Fax Modem with Software

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 - 15" SVGA, 28 Digital Color Monitor
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- Premium speaker system
- Enhanced IDE Interface
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- Microsoft Windows for Workgroups
- 101-Key Enhanced Keyboard
- Transporter Menu System
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- 8MB RAM
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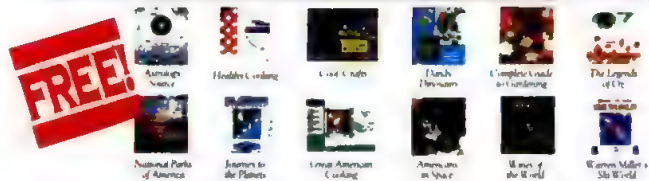
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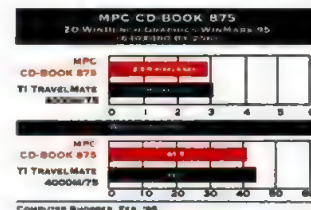


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	MPC CD-BOOK	PANASONIC V21
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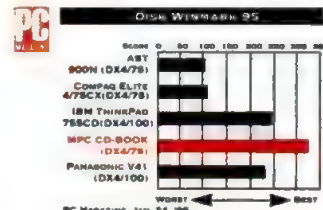
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72 PIN SIMMS (ESA)					
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16 x 36 32 mg	-	-	1189	00	1189	00	1189	00
16 x 36 64 mg	-	-	2745	00	2745	00	2745	00
16 x 36 128 mg	-	-	189	00	189	00	189	00
16 x 36 256 mg	-	-	345	00	345	00	345	00
16 x 36 512 mg	-	-	325	00	325	00	325	00
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16 x 36 4096 mg	-	-	325	00	325	00	325	00
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16 x 36 131072 mg	-	-	325	00	325	00	325	00
16 x 36 262144 mg	-	-	325	00	325	00	325	00
16 x 36 524288 mg	-	-	325	00	325	00	325	00
16 x 36 1048576 mg	-	-	325	00	325	00	325	00
16 x 36 2097152 mg	-	-	325	00	325	00	325	00
16 x 36 4194304 mg	-	-	325	00	325	00	325	00
16 x 36 8388608 mg	-	-	325	00	325	00	325	00
16 x 36 16777216 mg	-	-	325	00	325	00	325	00
16 x 36 33554432 mg	-	-	325	00	325	00	325	00
16 x 36 67108864 mg	-	-	325	00	325	00	325	00
16 x 36 134217728 mg	-	-	325	00	325	00	325	00
16 x 36 268435456 mg	-	-	325	00	325	00	325	00
16 x 36 536870912 mg	-	-	325	00	325	00	325	00
16 x 36 1073741824 mg	-	-	325	00	325	00	325	00
16 x 36 2147483648 mg	-	-	325	00	325	00	325	00
16 x 36 4294967296 mg	-	-	325	00	325	00	325	00
16 x 36 8589934592 mg	-	-	325	00	325	00	325	00
16 x 36 17179869184 mg	-	-	325	00	325	00	325	00
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16 x 36 137438953472 mg	-	-	325	00	325	00	325	00
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16 x 36 1099511627776 mg	-	-	325	00	325	00	325	00
16 x 36 2199023255552 mg	-	-	325	00	325	00	325	00
16 x 36 4398046511104 mg	-	-	325	00	325	00	325	00
16 x 36 8796093022208 mg	-	-	325	00	325	00	325	00
16 x 36 17592186044416 mg	-	-	325	00	325	00	325	00
16 x 36 35184372088832 mg	-	-	325	00	325	00	325	00
16 x 36 70368744177664 mg	-	-	325	00	325	00	325	00
16 x 36 140737488355328 mg	-	-	325	00	325	00	325	00
16 x 36 281474976710656 mg	-	-	325	00	325	00	325	00
16 x 36 562949953421312 mg	-	-	325	00	325	00	325	00
16 x 36 1125899906842624 mg	-	-	325	00	325	00	325	00
16 x 36 2251799813685248 mg	-	-	325	00	325	00	325	00
16 x 36 4503599627370496 mg	-	-	325	00	325	00	325	00
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16 x 36 18014398509481984 mg	-	-	325	00	325	00	325	00
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16 x 36 72057594037927936 mg	-	-	325	00	325	00	325	00
16 x 36 144115188075855872 mg	-	-	325	00	325	00	325	00
16 x 36 288230376151711744 mg	-	-	325	00	325	00	325	00
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16 x 36 18446744073709551616 mg	-	-	325	00	325	00	325	00
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16 x 36 73786976294838206464 mg	-	-	325	00	325	00	325	00
16 x 36 147573952589676412928 mg	-	-	325	00	325	00	325	00
16 x 36 295147905179352825856 mg	-	-	325	00	325	00	325	00
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16 x 36 1180591620717411303424 mg	-	-	325	00	325	00	325	00
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16 x 36 75557863725914323419136 mg	-	-	325	00	325	00	325	00
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16 x 36 604462909807314587353088 mg	-	-	325	00	325	00	325	00
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16 x 36 4835703278458516698824704 mg	-	-	325	00	325	00	325	00
16 x 36 9671406556917033397649408 mg	-	-	325	00	325	00	325	00
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16 x 36 618970019642690137449562112 mg	-	-	325	00	325	00	325	00
16 x 36 1237940039285380274899124224 mg	-	-	325	00	325	00	325	00
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16 x 36 4951760157141521099596496896 mg	-	-	325	00	325	00	325	00
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16 x 36 19807040628566084398385987584 mg	-	-	325	00	325	00	325	00
16 x 36 39614081257132168796771975168 mg	-	-	325	00	325	00	325	00
16 x 36 79228162514264337593543950336 mg	-	-	325	00	325	00	325	00
16 x 36 158456325028528675187087900672 mg	-	-	325	00	325	00	325	00
16 x 36 316912650057057350374175801344 mg	-	-	325	00	325	00	325	00
16 x 36 633825300114114700748351602688 mg	-	-	325	00	325	00	325	00
16 x 36 1267650600228229401496703205376 mg	-	-	325	00	325	00	325	00
16 x 36 2535301200456458802993406410752 mg	-	-	325	00	325	00	325	00
16 x 36 5070602400912917605986812821504 mg	-	-	325	00	325	00	325	00
16 x 36 10141204801825835211973625643008 mg	-	-	325	00	325	00	325	00
16 x 36 20282409603651670423947251286016 mg	-	-	325	00	325	00	325	00
16 x 36 40564819207303340847894502572032 mg	-	-	325	00	325	00	325	00
16 x 36 81129638414606681695789005144064 mg	-	-	325	00	325	00	325	00
16 x 36 162259276829213363391578010288128 mg	-	-	325	00	325	00	325	00
16 x 36 324518553658426726783156020576256 mg	-	-	325	00	325	00	325	00
16 x 36 649037107316853453566312041152512 mg	-	-	325	00	325	00	325	00
16 x 36 1298074214633706907132624082305024 mg	-	-	325	00	325	00	325	00
16 x 36 2596148429267413814265248164610048 mg	-	-	325	00	325	00	325	00
16 x 36 5192296858534827628530496329220096 mg	-	-	325	00	325	00	325	00
16 x 36 10384593717069655257060992658440192 mg	-	-	325	00	325	00	325	00
16 x 36 20769187434139310514121985316880384 mg	-	-	325	00	325	00	325	00
16 x 36 41538374868278621028243970633760768 mg	-	-	325	00	325	00	325	00
16 x 36 83076749736557242056487941267521536 mg	-	-	325	00	325	00	325	00
16 x 36 166153499473114484112975882535043072 mg	-	-	325	00	325	00	325	00
16 x 36 332306998946228968225951765070086144 mg	-	-	325	00	325	00	325	00
16 x 36 664613997892457936451903530140172288 mg	-	-	325	00	325	00	325	00
16 x 36 1329227995784915872903807060280344576 mg	-	-	325	00	325	00	325	00
16 x 36 2658455991569831745807614120560689152 mg	-	-	325	00	325	00	325	00
16 x 36 5316911983139663491615228241121378304 mg	-	-	325	00	325	00	325	00
16 x 36 10633823966279326983230456482242756608 mg	-	-	325	00	325	00	325	00
16 x 36 21267647932558653966460912964485513216 mg	-	-	325	00	325	00	325	00
16 x 36 42535295865117307932921825928971026432 mg	-	-	325	00	325	00	325	00
16 x 36 85070591730234615865843651857942052864 mg	-	-	325	00	325	00	325	00
16 x 36 170141183460469231731687303715884105728 mg	-	-	325	00	325	00	325	00
16 x 36 340282366920938463463374607431768211456 mg	-	-	325	00	325	00	325	00
16 x 36 680564733841876926926749214863536422912 mg	-	-	325	00	325	00	325	00
16 x 36 1361129467683753853853498429727072845824 mg	-	-	325	00	325	00	325	00
16 x 36 2722258935367507707706996859454145691648 mg	-	-	325	00	325	00	325	00
16 x 36 5444517870735015415413993718908291383296 mg	-	-	325	00	325	00	325	00
16 x 36 10889035741470030830827987437816582766592 mg	-	-	325	00	325	00	325	00
16 x 36 21778071482940061661655974875633165533184 mg	-	-	325	00	325	00	325	00
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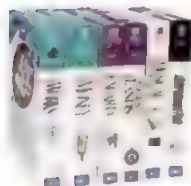
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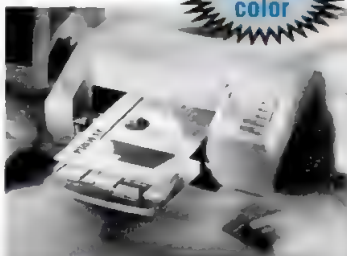
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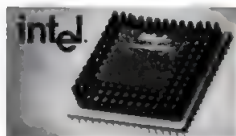


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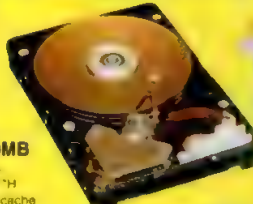


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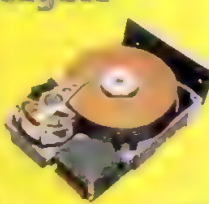


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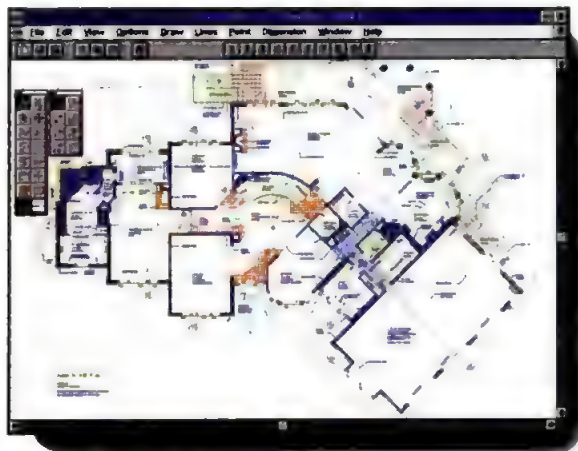
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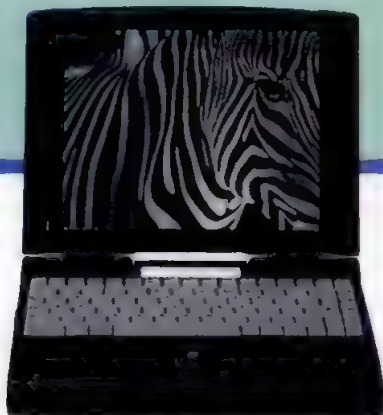
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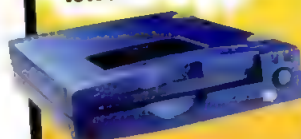
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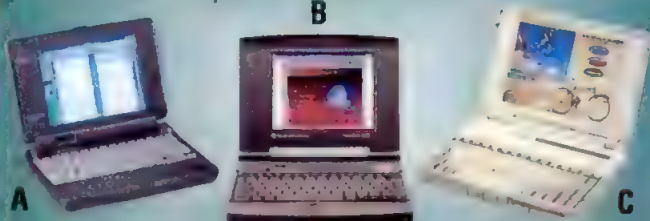
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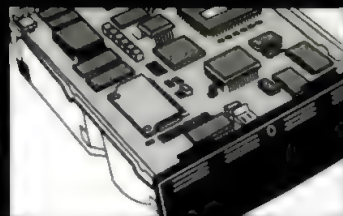
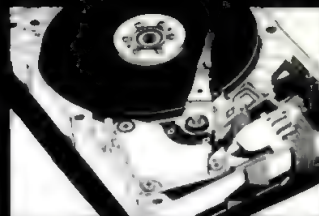
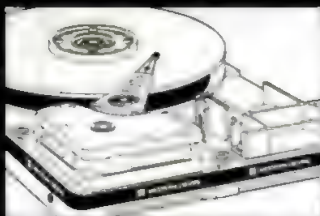
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1275MB	9ms	CNR1275A	\$379	
SCSI				
1080MB	11ms	CFP1080S	\$479	
2147MB	8.5ms	CFP2105S	\$879	
2147MB	8.5ms	CFP2107S	\$989	

MICROPOLIS

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9100MB	12ms	MC1991W	\$2799	
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IDE				
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545MB	14ms	ST3660A	\$195	
722MB	12ms	ST3780A	\$245	
850MB	12ms	ST3850A	\$259	
1083MB	12ms	ST31220A	\$369	
SCSI (WIDE SCSI also available)				
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2147MB	9ms	ST32430N	\$939	
2147MB	8ms	ST32550N	\$979	
4290MB	9ms	ST15230N	\$1339	
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1280MB	10ms	AC31200	\$399	

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731MB	11ms	LT730A	\$249	
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Sony	CDU55S	2X	250ms	\$159
Sanyo	SH93R	2X	280ms	\$149
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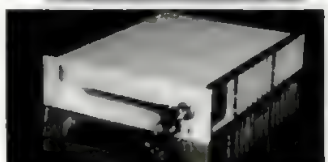
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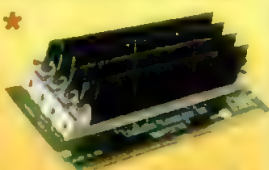
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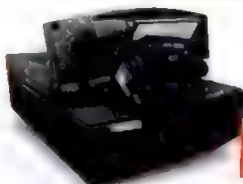
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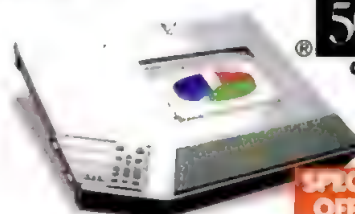


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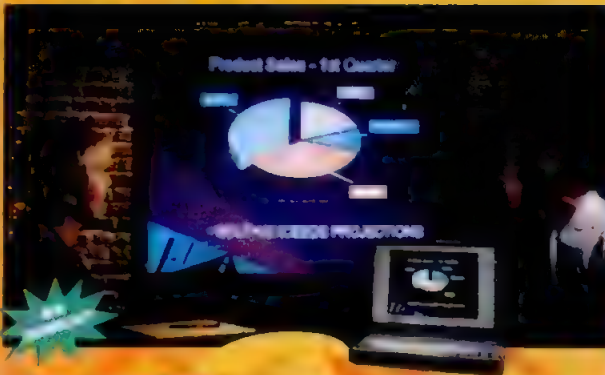
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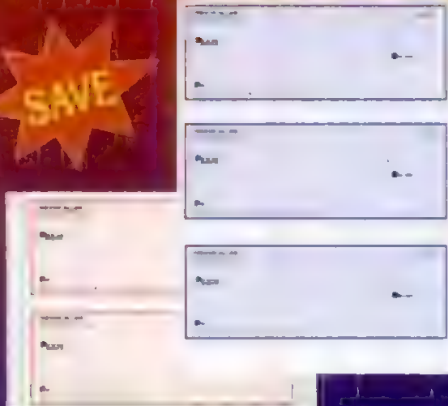
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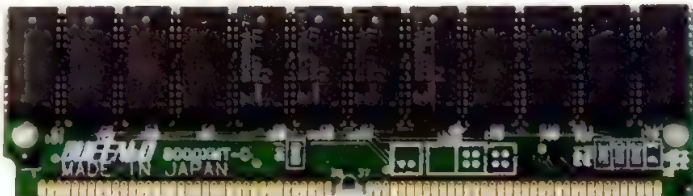
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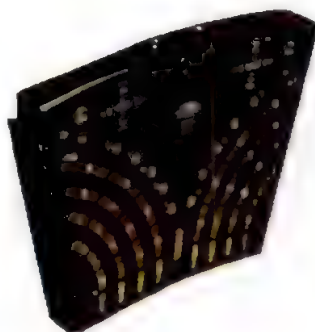
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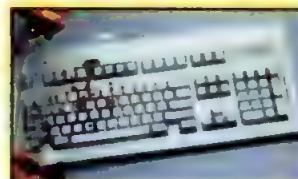


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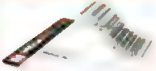
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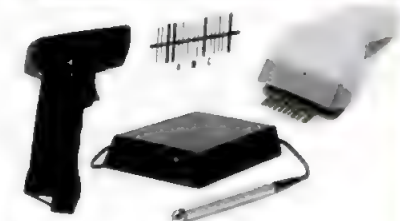
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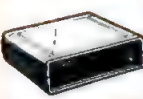
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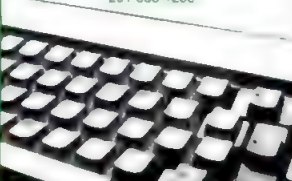
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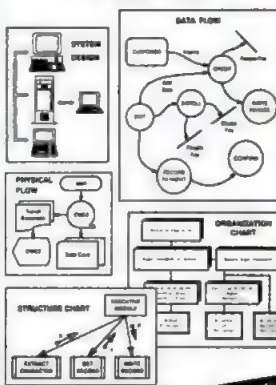


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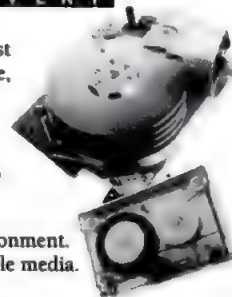
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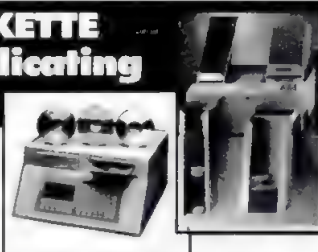
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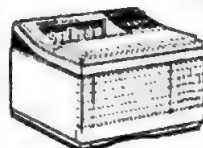


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Coming Up

The Small Office Comes of Age

Home offices, small businesses, branch offices, telecommuting centers, mobile offices. More advanced and more affordable PC technology has made all of these alternatives viable by giving individuals access to the same technological resources once reserved for large corporations.

In this overview, we take a comprehensive look at the migration of the work force away from monolithic office towers and show you the hardware, software, and communications tools you'll need to work effectively on your own. We also examine the newest class of multifunction printers and survey the emerging voice-mail products that will make your small office look to the outside world like one of the big boys.

Multifunction Printers

If you've ever used a Swiss Army knife, you know it's not the best knife, or the best corkscrew, or the best scissors. But the allure is that it's all of these tools in a convenient, compact, and affordable package.

That's the idea behind the new breed of multifunction peripherals. With so many small offices and home offices springing up, more and more people need a space-efficient and cost-effective way to get printing, faxing, copying, and scanning capabilities. We evaluate 16 multifunction units that vary widely in price, performance, and capabilities. Some are based around ink jet or laser printers, some started life as fax machines, and still others are scanners that enhance the functionality of your existing peripherals. These jacks-of-all-trades (and sometimes masters of none) may be just the solution you've been searching for.

Voice Mail for the Small Office

Voice mail is no longer the province of large companies. With modems now touting voice support, anyone with a PC can afford a sophisticated-sounding voice mail system that has the ability to send, receive, and forward fax messages. We lay out your voice mail options and review the products that you'll want for your small office.

Ad Hoc SQL Query Tools

The latest generation of GUI-based query and reporting tools offer new approaches to one of computing's oldest problems: turning data into information. But do you need to be a database expert in order to become an expert about your business? We evaluate seven market leaders to find which tools offer the power, safety, and built-in intelligence you need to sift through masses of relational data.

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Hardball 4 hits a homerun thanks to its stunning graphics.

Hardball 4

Accolade Inc.; 408-985-1700

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★★★★ DOS CD-ROM

Some things just keep getting better. Hardball 4, the latest rendition of Accolade's baseball classic, is ample proof; stunning graphics and intense gameplay make this a must-have for baseball fans.

Like any good sports game, the core of Hardball 4 is league play. You can build leagues with either generic players or the more than 700 included

MLBPA players. Each of the 28 teams can be controlled by human players, so Hardball 4 is perfect for tournament play. Modem play is also supported.

The game controls haven't changed from previous versions and are easy to learn. The graphics, on the other hand, have changed dramatically. Designed completely in 640-by-480 SVGA, Hardball 4 is a visual feast. All of the big-league ball parks are represented in exquisite detail, and the player animations are incredibly lifelike.

Adding to the realism is play-by-play commentary by Al Michaels, which is relatively smooth, but quirky. For example, when a batter comes to the plate, only his career batting average is announced, not his average for the current season.

Hitting in Hardball 4 is challenging but not impossible. Fielding is much more difficult. The controls are simple, but tough to master.

We may not get to see real baseball this year, but once you see Hardball 4, you may no longer care.

NASCAR Racing

Papyrus Design Group Inc.;

800-836-0033

Circle 454 on reader service card

★★★★ DOS CD-ROM

If you feel the need for speed, NASCAR Racing is right up your alley. The latest title from the makers of Indy Car Racing sets new standards for graphics and realism among racing sims.



NASCAR Racing brings speed to your PC.

NASCAR Racing puts you behind the wheel of a 3,500-pound stock car as you run a single race or try for a full racing season, which takes you through nine tracks. You can even play NASCAR Racing via modem.

The game features two graphics modes: 320-by-200 VGA or 640-by-480 SVGA. Once you try the SVGA mode, you probably won't go back; everything, from the cars to the asphalt, is beautifully detailed. Bear in mind that to run the game in high-resolution, you'll need a fast CPU and lots of memory. But by lowering some of the detail settings, you can make the game playable on moderately

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After Hours

equipped 486-based PCs.

There are no easy races in this game. Even steering is difficult, particularly with a standard joystick. But put in some time with NASCAR Racing and you'll never look at driving the same way again.

Slam City with Scottie Pippen

Digital Pictures Inc.;
415-345-5300

Circle 455 on reader service card

★★★★ CD-ROM 99.95

Welcome to Slam City, where the name of the game is streetball. To win, you'll need to dust off your best moves and get ready for some trash-talking.

Slam City is a first-person basketball game designed entirely in full-screen, full-motion video. The game spans four CDs and requires a Pentium. But if you've got the hardware to support Slam City you're in for a wild ride.

The object is simple: Beat four local hotshots and earn enough respect points to get a



Show your moves in Slam City with Scottie Pippen.

shot at NBA all-star Scottie Pippen, followed by a chance at making the pros. The good news is that gameplay is very straightforward. You can only move left and right and shoot or try a dunk on offense, and block or steal on defense.

The bad news is that your opponents grow steadily more

difficult as the game progresses. If, by a miracle, you beat each opponent *twice*, you'll have the 5 billion respect points to challenge Scottie. Then you'll probably start thinking that the other players were pushovers. To make things even tougher, you'll find that the graphic representation of your player sometimes obstructs your view of your opponent.

Play is tough and the game's hardware requirements are a bit extreme, but if you can stand up to the challenge, you might just meet up with Scottie in Slam City.

FrontPage Sports Football Pro '95

Sierra-On-Line Inc.;
206-649-9800

Circle 456 on reader service card

★★★★ CD-ROM 59.95

Kick off a new football season with FrontPage Sports Football Pro '95.

In this game, you take full control of an NFL team and manage everything from uniform color to trades to draft selections. You can play a single game, or opt for a Single Season or a Career that spans several seasons. You can customize your lineup and playbook to suit your tastes. This is Football Pro '95's strongest point: There are very few team features that

you can't customize.

One of Football Pro '95's weak points is the play-calling interface, which is a significant exercise in memorization. You have to choose from groups of plays identified only by number, then select one of the incomprehensibly named plays. Once you call a play, though,



Customize all aspects of your team in FrontPage Sports Football Pro '95.

things improve. Running and controlling the players is surprisingly easy, though passing can be extremely difficult.

Gameplay is enhanced by rich and colorful on-field graphics. The fields themselves are well textured and

the end-zone art for each team is faithfully depicted.

Football Pro '95 stands head and shoulders above the other football titles out there and should appeal to any fan who can memorize a playbook.

—Michael Ryan

ESPN Baseball Tonight

Batter up! You get everything but the artificial turf with this baseball game, which is detailed enough for the most gifted of cyber-ball players, but simple enough for the athletically challenged to master.

**CD-ROM
PICK
HIT**

You can play either a serious baseball simulation, where the statistics of the players are used to simulate the result, or play arcade-style, where you control the outcome of the game yourself—once you master the sometimes confusing interface. Sim fans will enjoy the player stats, logos, and ballparks. Others will enjoy controlling the on-field action. Whichever mode you choose, you'll appreciate the player videos and ESPN-style play-by-play.—Gayle C. Ehrenman
Sony Imagesoft; 310-449-2999

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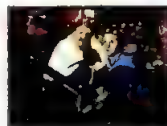
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503-241-4351

Circle 457 on reader service card

★★★★    \$29.95

When your child needs to know who invented the skateboard, or what the rules are for ice dancing, there's no better place to turn than *The Everything You Want To Know About Sports Encyclopedia*. This first release from *Sports Illustrated for Kids* manages to be highly entertaining and educational at the same time.

Home base is a room with a Myst feel to it, where you can

communicate with a robot helper, launch a trivia game, or click on an illustration of various sports equipment to explore a particular sport in the multimedia encyclopedia.

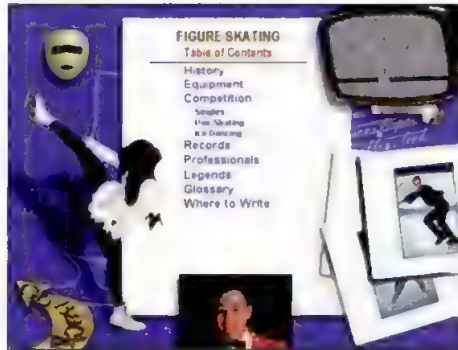
The encyclopedia covers 75 sports in all, ranging from kids' favorites such as snowboarding

and skateboarding, to standards such as baseball and tennis, to more unusual sports such as bocce and bullfighting. The information is presented in easy-to-read articles that cover the history and legends of the sport, and the rules and regulations. Many sports also receive photo and video coverage.

Everything is very kid friendly, from the graphical interface to the tone of the text.

The only unfriendly part is the digital host of the trivia game. Miss a question here and you'll meet with sarcastic comments. This is but a minor caveat to an otherwise outstanding product.

—Gayle C. Ehrenman



Get all the facts on your favorite sports with this *Sports Illustrated for Kids* CD-ROM.

Kids

Learning How, Why, and Where in a Land of Fun

How Things Work in Busytown

Viacom New Media;
800-469-2539

Circle 458 on reader service card

★★★★    \$49.95

Lowly Worm rises to new heights flying his Applecopter and learning How Things Work in Busytown. This engaging CD-ROM program, based on the famous Richard Scarry characters, teaches young children the how and the why behind

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After Hours



Find out how the activities of a community relate to each other in *How Things Work in Busytown*.

many community tasks. Along the way, kids learn that everything that happens in Busytown helps the community thrive.

Children select their own paths as they explore seven theme playgrounds, including the Farm, the Flour Mill, the Bakery, and the Recycling Center. In each of these locations kids meet engaging characters such as Huckle Cat and Hilda Hippo, and help them complete their tasks, while

they learn the basics of recycling, flour grinding, farming, and more.

How Things Work in Busytown offers young players two modes of exploration, Easy and Advanced. In the Easy level, children are given visual hints and mechanical assists to help them complete tasks; in the Advanced level, children work on their own to complete jobs. Kids learn that performing some jobs can be dependent upon other people com-

QUICK CLIPS

Recommended
It's Your Call
Not Recommended

? Battle Chess Collection

I enjoy watching Medieval knights fight it out as much as the next gamer, but I'd rather have a new Battle Chess than just four old games on one CD-ROM, no matter how reasonably it's priced. \$29.99; Interplay Productions; 714-553-6655.

Microsoft Complete Baseball '95

This updated version of the must-have CD-ROM for diamond lovers adds more multimedia, improved navigation, and best of all, a new section on ballparks. All that's missing are the players. \$49.95; Microsoft Corp.; 206-882-8080.

? Take Five

Zen meets multimedia in this four-part relaxation program on CD-ROM. The stretching exercises and images are all very interesting, but staring at a computer is not my idea of relaxing. \$29.95; The Voyager Company; 800-446-2001.

Warren Miller's Ski World

Whether you want to compile your own cool action video, find the best trails in your area, or learn to ski, you need only power up this funky fun-filled CD-ROM and wait for next winter's snow. \$49.95; Multicom Publishing; 206-622-5530.

pleting their tasks first; for example, the Baker can't make pretzels until Hilda Hippo grinds flour at her Mill and then delivers it.

The program is easy to navigate and the narrations and visual aides are helpful in

guiding children's actions; the youngest players, though, may need some initial help from Mom or Dad. The effort will be well spent, though, because the lessons the program teaches are both important and fun.

—Charles Taft

SPOTLIGHT ON ACTION

X-Wing Collector's CD-ROM

For many of us, it seemed unfair that TIE Fighter (LucasArts' space combat simulator that lets you fight on Darth Vader's side) got the spiffy new goraud-shading polygon engine, while X-Wing put you on the side of the Rebel Alliance but saddled you with primitive-looking graphics.

Virtual foes of the Empire need not gnash their teeth in darkness any longer, because LucasArts has just released an enhanced X-Wing Collector's CD-ROM, which not only includes the two previously released additional tours of duty, B-Wing and Imperial Pursuit, but



also throws in a handful of new missions to boot. The most notable addition here is the use of goraud shading on all the X-Wing spaceships, making them appear

more realistic without interrupting the flow of the game.

Despite the cosmetic improvements, X-Wing Collector's CD-ROM retains the unforgiving mission-success parameters that made playing the game somewhat maddening. If you've already played X-Wing and the additional mission add-ons, you may not be interested in this version. But if you are new to the LucasArts Star Wars games, you'll find that the Force runs strong in X-Wing Collector's CD-ROM.

—Bernard H. Yee

Lucas Arts Entertainment Co.;
800-782-7927

Circle 459 on reader service card

★★★ CD-ROM \$59.95

Abort, Retry, Fail?

THE LIGHTER SIDE OF PERSONAL COMPUTING

By Don Willmott

Hey, Max, You Should See Unix!

Faithful reader Tony Charboneau was having some Windows trouble as he tried to play a game with his six-year-old son, Max. "Can I play it in the dark place?" asked Max. Tony was unsure what Max meant until he exited out to DOS. "That's the dark place!" Max exclaimed.

Internet training seminar:

She: "I'm thinking of setting up a World-Wide Web home page."

He: "Oh, really? Well, I have some extra server space you can use if you need a place to post it."

Tarrytowns plan dance for computers

A nonprofit corporation dedicated to underwriting programs at Tarrytown schools is holding a murder mystery dinner dance tomorrow to earn money for computers.

Do you suppose they'll do the Electric Slide? (Reporter Dispatch, Westchester County, NY.)



On the World-Wide Web, go to <http://cbl.tamucc.edu/~pmichaud/toast/> to see an analysis and illustration of how strawberry Pop Tarts will explode into flames if you leave them in the toaster too long.

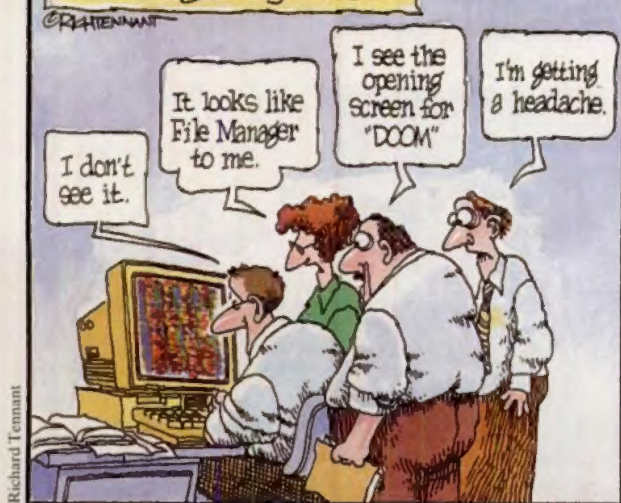
Overheard

Here it is, folks—the pick-up line of the 1990s, overheard at a recent Microsoft

And Be Especially Sure If It's The Lion King

Our Maryland correspondent tells us that Roadrunner Video in Silver Spring is branching out by renting games on CD-ROM, and guess what? Right in the middle of each jewel case is a sticker with that familiar, friendly suggestion: "Be Kind, REWIND!"

MARKETING MIS-STEPS: The Magic-Eye GUI



Farm Animals/Livestock

Huh? Further explanation would be helpful. (Thrifty Nickel Want Ads, Iowa.)

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If your entry is used, we'll send you \$50 and a PC Magazine T-shirt. Send your entries to Abort, Retry, Fail?, PC Magazine, One Park Ave., New York, NY 10016-5802. Winners this issue: Ed Calkins, Tony Charboneau, Bill Rubin, Marc Sheinberg, Sean Sullivan, and Deanna Vincent.

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